Vol. III OCTOBER, 1917 No. 10

The INTERNATIONAL JOURNAL OF ORTHODONTIA

A Monthly Journal Devoted to the Advancement of the Science of Orthodontia

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The International Journal of Orthodontia

Editor: Martin Dewey, D.D.S., M.D.

VOL. III ST. LOUIS, OCTOBER, 1917 NO. 10

ORIGINAL ARTICLES

THE DEVELOPMENT OF THE BONES OF THE FACE*

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STATEMENTS in this paper regarding development earlier than that found at the sixtieth day of embryonic life are brief summaries expressing the consensus of opinions held by the majority of embryologic observers. Statements regarding development later than the sixtieth day of embryonic life are based chiefly upon the study of my own sections and dissections of a series of one hundred and forty-five specimens covering the periods of development from the sixty-day fetus to adult life. In addition to the facial bones proper, the frontal, ethmoid and sphenoid bones will be considered because of their close relations to the facial area.

At the end of the second week of intrauterine life, human embryos show the first appearance of the primordial cranium in the mesenchyme investing the anterior portion of the notochord. From this there is an extension dorsally to inclose the anterior portion of the medullary canal, which will later become the cerebral portion of the central nervous system. From that part of the primordial cranium which extends forward beyond the anterior portion of the notochord, a core is formed for the frontonasal process—a relatively broad mass of tissue which later separates the nasal pits. Beginning development of the nasal area is shown, during the third week of embryonic life, by increasing thickness of the ectoderm on the anterolateral portions of the forebrain. During the fourth week, the increasing thickness of the surrounding mesenchyme causes the nasal areas to appear as symmetric depressions or nasal pits, which are at first pyriform in outline, with the small ends toward the primitive mouth cavity (Fig. 1).

*Read before the American Society of Orthodontists at its sixteenth annual meeting, Pittsburgh, Pa., July 21, 1916.

In the early stages of development the nasal and oral fossæ form one cavity. The superior boundary is formed by the median frontonasal process, on each lateral portion of which is the processus globularis. Laterally, the boundaries develop from the first visceral or branchial arches, which grow ventrally until they meet in the median line, and thus come to also form the inferior

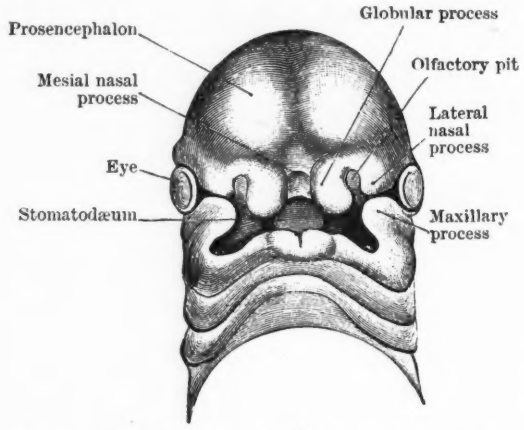

Fig. 1.—Head of twenty-eight day embryo. (His.)

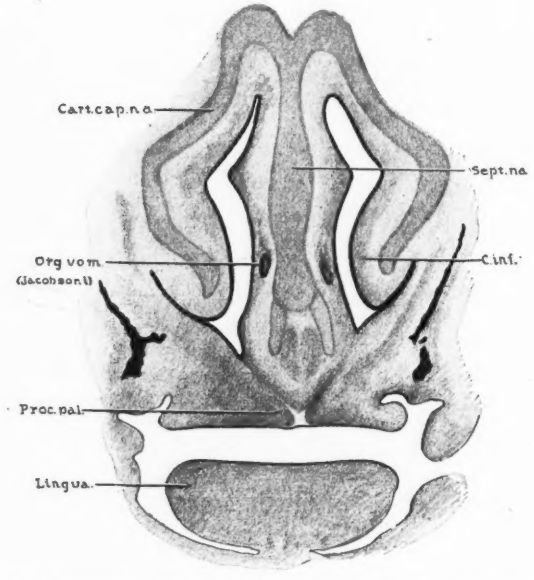

Fig. 2.—Diagram drawn from a coronal section through nasal area of a sixty-day embryo. (Series A, No. 1, slide 6, section 6. × 16⅔.)

Sept.na., Septum nasi; note relative thickness at this stage of development; *C.inf.*, concha inferior; *Proc.pal.*, processus palatinus of maxilla; *Org.vom.*, organon vomeronasale (Jacobsoni); *Cart.cap.na.*, cartilago capsulæ nasalis.

boundary. The lower portions of the first visceral arches are converted into the mandible and the soft tissues investing it, while from the upper portions the maxillary processes grow anterosuperiorly, and from them the portion of the face between the mouth and the orbits is developed, and in it the maxillæ, malar,

Note.—Figs. 2-8 and 12-29 are taken from Davis: "Nasal Accessory Sinuses," by courtesy of W. B. Saunders Co.

and palate bones, and probably the internal pterygoid plates are developed and ossified.

As the processus globularis and the lateral nasal and maxillary processes approximate, their ectodermal coverings are brought into contact. The intervening ectoderm is then resorbed and the processes become united by mesoderm, thus forming the floor of the primitive nares. The broad median process separating the nasal depressions later becomes narrowed and forms the septum nasi.

The palatal ridges appear on the medial sides of the maxillary processes from the forty-fifth to forty-eighth day of embryonic life (J. P. Schaeffer), and by their approximation the anterior portion of the palate is formed, fusing an-

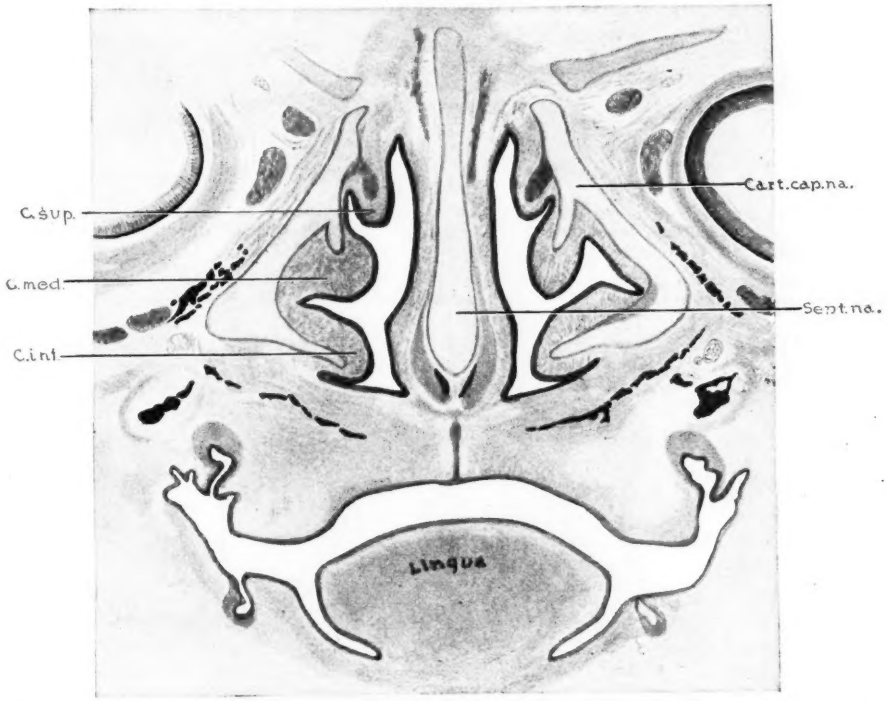

Fig. 3.—Diagram of coronal section through nasal area of a sixty-five-day embryo. (Series A, No. 3, slide 7, section 3. × 16.)

Cart.cap.na., Cartilago capsulæ nasalis; *Sept.na.*, septum nasi; *C.inf.*, concha inferior; *C.med.*, concha media; *C.sup.*, concha superior. Note ossification centers of the vomer.

teriorly with the premaxillary process and behind this with each other (Fig. 2). Fusion has usually taken place between the maxillary and globular processes during the eighth week, between the palatal ledges of the maxillary processes about the tenth week, and between the horizontal portions of the palate bones about the eleventh or twelfth week. Failure in this fusion results in cleft palate, or harelip and cleft palate, the clinical variety of the cleft depending upon the extent of nonfusion between these processes.

The basal part of the primordial craninum develops into chondrocranium. Laterally, the basal plates develop as the periotic capsules, ventrally they form the mesethmoid plate, and anterolaterally they enter into the formation of the nasal capsule, which in the second month shows distinct cartilaginous

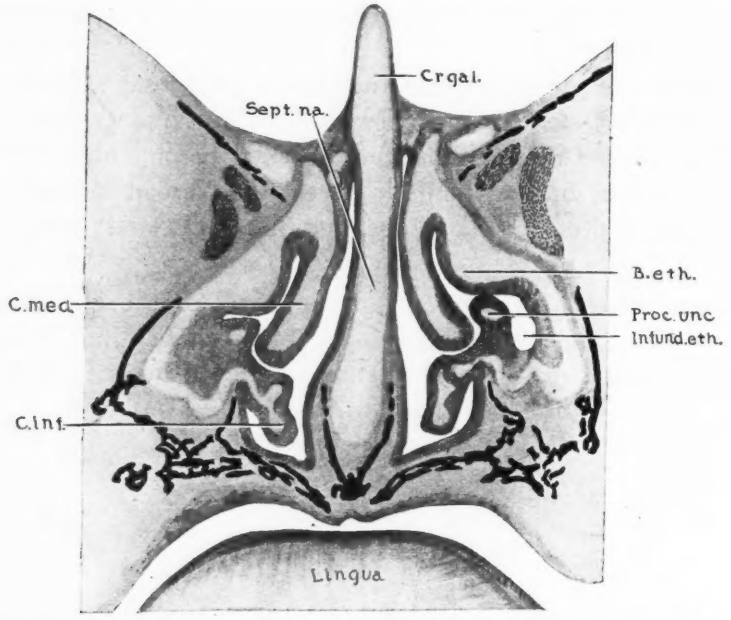

Fig. 4.—Diagram of coronal section through the anterior third of the nasal area of a ninety-five-day embryo, to show the extent of development and relations of the processus uncinatus and the bulla ethmoidalis. (Series A, No. 6, slide 11, section 6. × 10.)

Cr.gal., Crista galli; *B.eth.*, bulla ethmoidalis; *Proc.unc.*, processus uncinatus; *Infund.eth.*, infundibulum ethmoidale; *C.inf.*, concha inferior; *C.med.*, concha media; *Sept.na.*, septum nasi.

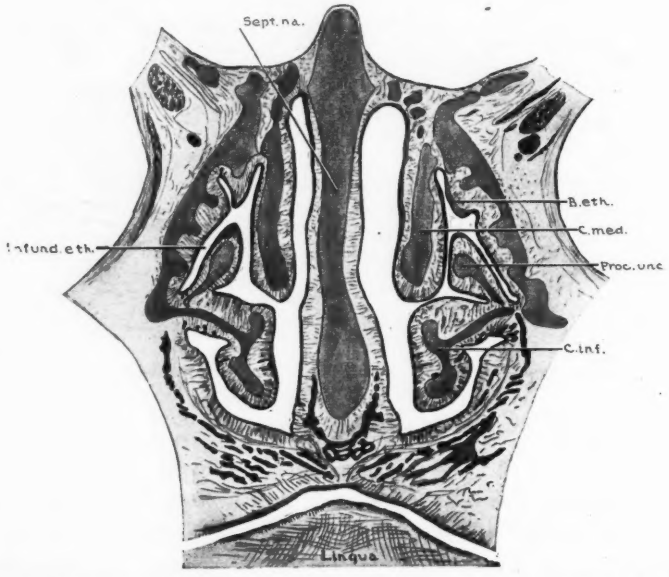

Fig. 5.—Diagram drawn from a coronal section near the midpoint anteroposteriorly of the lateral nasal wall. (Series A, No. 12 (one-hundred-and-twenty-one-day fetus), slide 8, section 1. × 6.)

B.eth., Bulla ethmoidalis; *C.med.*, concha media; *Proc.unc.*, processus uncinatus; *C.inf.*, concha inferior; *Infund.eth.*, infundibulum ethmoidale; *Sept.na.*, septum nasi.

development (Fig. 2). The chondrocranium reaches its highest relative development in the third month of intrauterine life. Most of the bones of the base of the skull are first formed of the cartilage and the cartilage is later replaced by bone (substitution bone). On the other hand most of the bones of the face and the flat bones of the skull are formed directly in membranous tissue (intra-

membranous bone). Some of the bones are partly membranous and partly cartilaginous in origin.

Ossification begins during the second month of intrauterine life. Mall (1906) has found centers of ossification for the mandible (thirty-ninth day), maxilla (thirty-ninth day) and premaxilla (forty-second day), before any center of ossification has appeared in the chondrocranium. The first centers of ossification to appear in the chondrocranium are those in the occipitale laterale (fifty-sixth day), the basioccipital (sixty-fifth day), orbitosphenoid (eighty-third day) and basisphenoid (eighty-third day). The chondrocranium is largely but not completely replaced by bone. The cartilages of the septum and alæ of the nose represent remnants of the chondrocranium.

Ossification centers appear in the mesenchyme of the facial area to form the nasal, lacrymal and malar bones. The center for each nasal bone appears, at the end of the second month, on the surface of the cartilaginous nasal capsule, the underlying cartilage being absorbed early in postnatal development

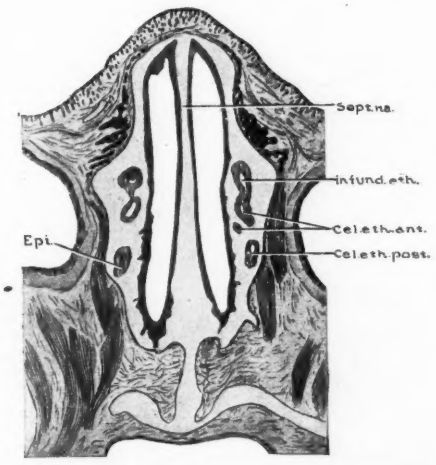

Fig. 6.—Diagram drawn from a horizontal section just above the anterior attachment of the concha superior. (Series A, No. 13 (one-hundred-and-twenty-six-day fetus), slide 10, section 1. × 3.)

Specimen shows the processes of pneumatization developing superiorly into the lateral masses of the ethmoid, thus forming the primitive cellulæ ethmoidales. *Sept.na.*, Septum nasi; *Infund.eth.*, infundibulum ethmoidale; *Cel.eth.ant.*, cellulæ ethmoidales anterior; *Cel.eth.post.*, cellulæ ethmoidales posterior; *Epi.*, epithelial invagination from meatus superior.

(Bardeen). The malar bone appears as a three-cornered center about the sixty-fifth day (Mall), becoming four-cornered a few days later. These corners form the two orbital, the maxillary, and the temporal processes of the bone as it assumes its more definite form. In the third month (eighty-third day) (Mall), a center for the lacrymal bone appears on the posterior part of the cartilaginous capsule of the external nose.

In studying the development of the facial bones arising from the first branchial arch, it is found that a cartilaginous bar develops only in the dorsal portion of the maxillary process. The cartilage becomes invested and gradually replaced by membrane bone which eventually fuses with the sphenoid bone, forming its internal pterygoid plate (Bardeen). In the more ventral portions of the maxillary process, two membrane bones, the palatine and the maxilla, are developed. The palatine has a single center of ossification appearing in

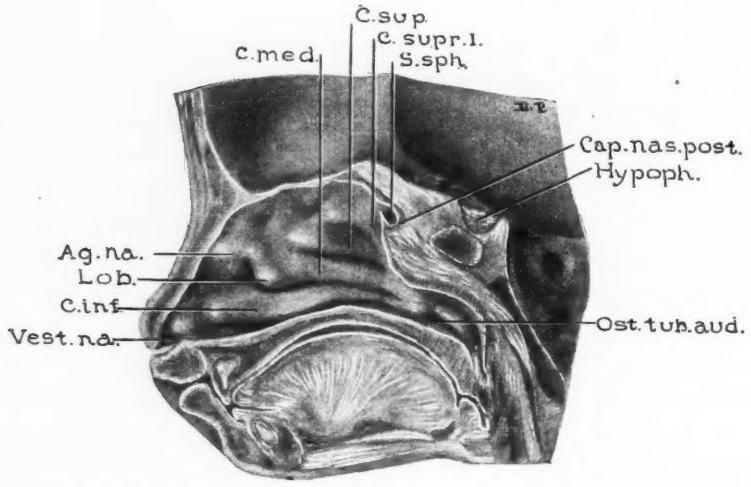

Fig. 7.—Sagittal section ¾ mm. to the right of median line anteriorly and 1¼ mm. to right of median line posteriorly through the body of the sphenoid. (Fetus one hundred and thirty-five days old. Series B, No. 1. × 1⅓.)

Shows the lateral nasal wall and the developing sinus sphenoidalis which extends into the remnant of the posterior portion of the cartilaginous nasal capsule. The concha sphenoidalis (ossiculum Bertini) develops in that portion of the cartilage which forms the antero-inferior boundary of the primitive sinus sphenoidalis. *Cap.nas.post.*, Capsula nasalis posterior; *Hypoph.*, hypophysis; *Ost.tub.aud.*, ostium tubæ auditivæ; *Vest.na.*, vestibulum nasi; *C.inf.*, concha inferior; *Lob.*, lobulus; *Ag.na.*, agger nasi; *C.med.*, concha media; *C.sup.*, concha superior; *C.supr.I.*, concha suprema I; *S.sph.*, sinus sphenoidalis.

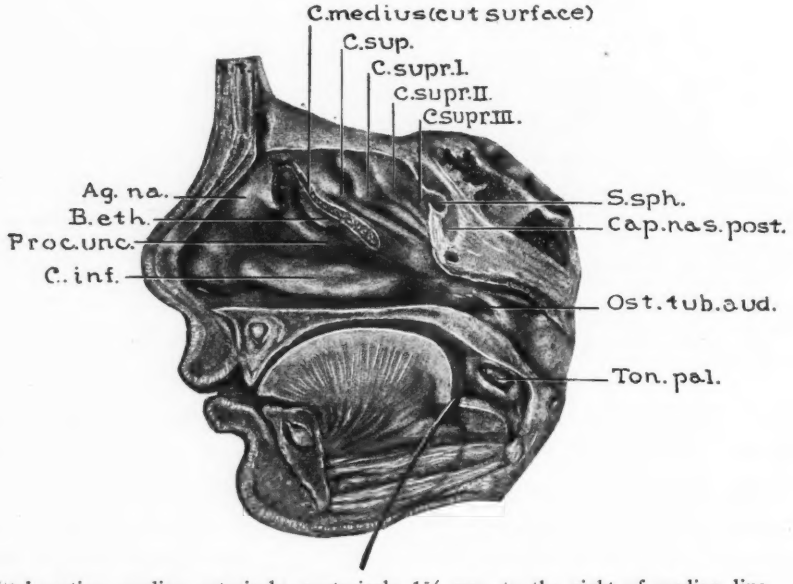

Fig. 8.—Sagittal section, median anteriorly, posteriorly 1¼ mm. to the right of median line. (Fetus one hundred and eighty-eight days old. Series B, No. 4.)

The greater portion of the concha media has been removed in order to show the relations of the recessus conchalis, processus uncinatus, hiatus semilunaris, and bulla ethmoidalis. This specimen shows the presence of five conchæ ethmoidales, the only specimen in the entire series having so great a number. Note the extent of development of the sinus sphenoidalis. *C.med.*, Concha media (cut surface); *C.sup.*, concha superior; *C.supr.I*, concha suprema I; *C.supr.II*, concha suprema II; *C.supr.III*, concha suprema III; *S.sph.*, sinus sphenoidalis; *Cap.nas.post.*, Capsula nasalis posterior; *Ost.tub.aud.*, ostium tubæ auditivæ; *Ton.pal.*, tonsilla palatina; *C.inf.*, concha inferior; *Proc.unc.*, processus uncinatus; *B.eth.*, bulla ethmoidalis; *Ag.na.*, agger nasi.

the eighth week (Mall) in the region corresponding to the angle between the horizontal and vertical parts. For each maxilla five centers of ossification are usually described—one giving rise to that portion of the alveolar region containing the molars and premolars, a second forms the nasal process and the part of the alveolar process containing the canine tooth, a third which contains the incisor teeth, and a fourth and fifth which lie above the first and give rise to the inner and outer portions of the orbital plate and the body of the bone (McMurrich). Mall (1906), however, describes only two centers—one for each of the distinct parts of the maxilla—the premaxilla, or medial portion, and a lateral or maxilla proper. Both centers appear during the sixth week and usually become united by the early part of the third month.

The mandible is ossified in the membranous tissue lateral to Meckel's car-

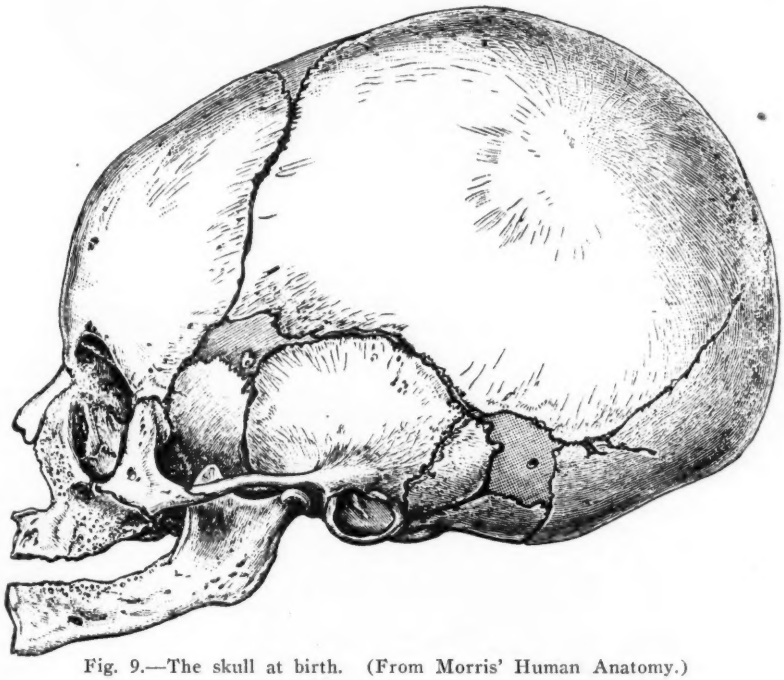

Fig. 9.—The skull at birth. (From Morris' Human Anatomy.)

tilage. Its ossification center may appear as early as the thirty-ninth day. By the forty-second day the ramus and the alveolar process may be distinguished. By the fifty-fifth day the coronoid process and condyle are demonstrable, and by the eightieth day the mandible shows its characteristic shape (Bardeen). At birth the lower jaw usually consists of the two lateral parts united by fibrous tissue at the symphysis. Osseous union takes place during the first year.

The frontal—a membrane bone—develops from two centers, one on each side of the median line. The two portions fuse and form a single bone in early postnatal development, though indications of the median suture not infrequently persist.

The ethmoid develops from the chondrocranium and has three centers of ossification—one for each lateral mass and one extending from the crista galli into the median plate. The centers for the lateral masses develop first, appearing in the lateral wall of the nasal capsule in the fifth or sixth fetal month, giving rise

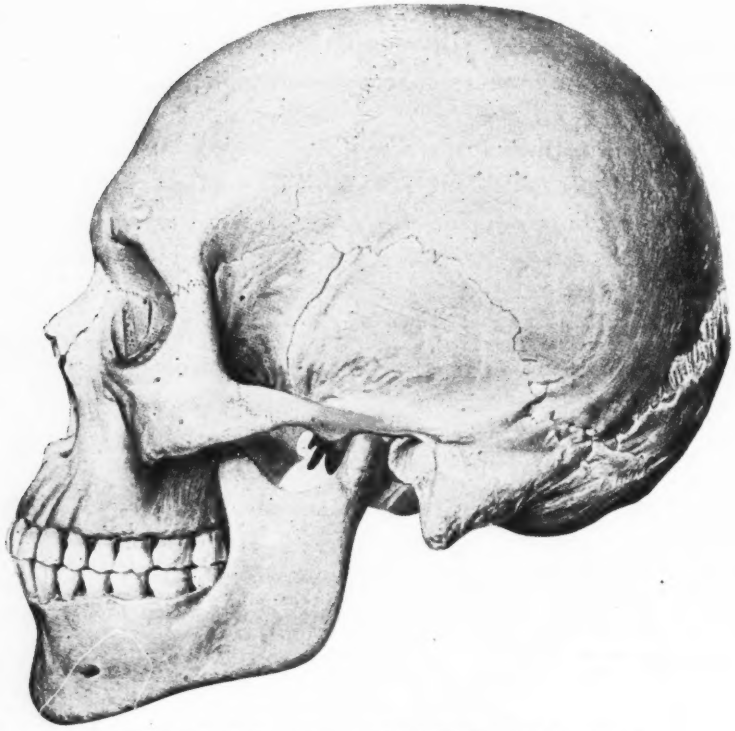

Fig. 10.—Adult skull. (From Sobotta-McMurrich Anatomy.)

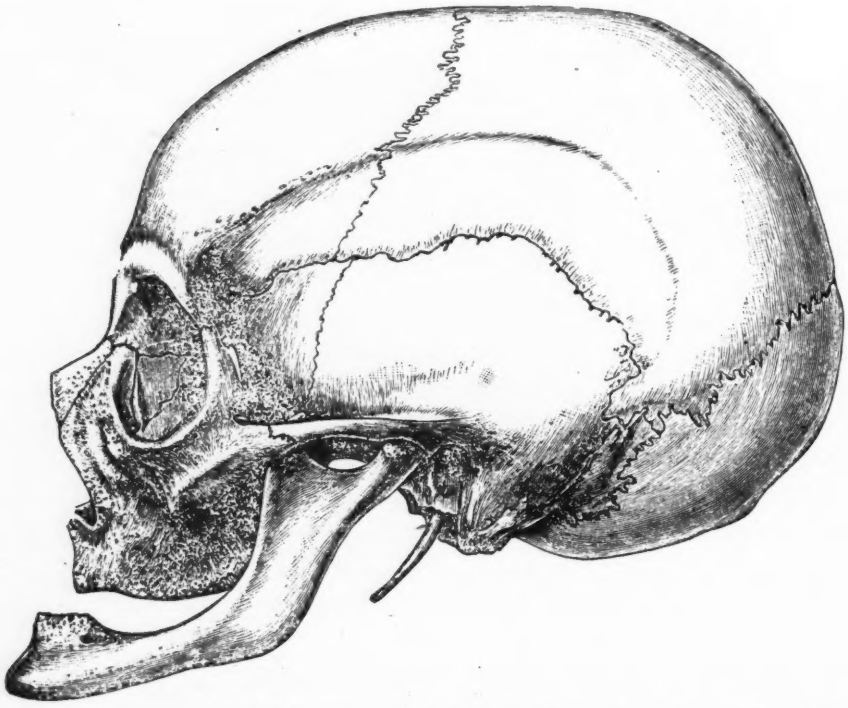

Fig. 11.—Skull of a woman eighty-three years old, to show the changes in the mandible and maxilla. (From Morris' Human Anatomy.)

to the lamina papyracea. In the seventh and eighth months ossification extends into the conchae. Ossification of the vertical plate begins about the sixth postnatal month. Accessory nuclei appear in the lamina cribrosa during the second year and by the fourth or fifth year the lateral and medial parts are united. Ossification, however, is not complete until after puberty.

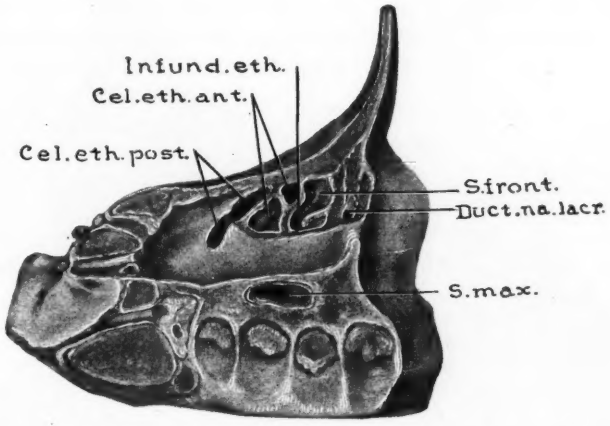

Fig. 12.—Specimen from a child eight days old. (Series D, No. 1.)

By sagittal sections removing the lateral portion of frontal bone, lamina papyracea of ethmoid, and lateral portion of maxilla—the sinus maxillaris, cellulæ ethmoidales, anterior and posterior, infundibulum ethmoidale, and the primitive sinus frontalis are brought into view. *S.front.*, Primitive sinus frontalis; *Duct.na.lacr.*, ductus nasolacrimalis; *S.max.*, sinus maxillaris; *Cel.eth.post.*, cellulæ ethmoidales posterior; *Cel.eth.ant.*, cellulæ ethmoidales anterior; *Infund.eth.*, infundibulum ethmoidale.

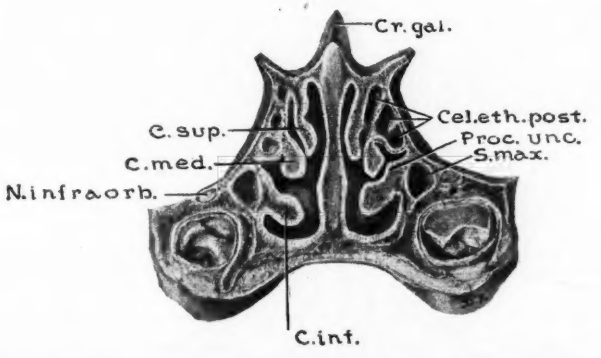

Fig. 13.—Specimen from a child one month and eight days old. (Series D, No. 2.)

Posterior view of coronal section cut 16 mm. posterior to the nasion, showing the extent of superoinferior and lateral development of sinus maxillaris and cellulæ ethmoidales posterior. Note the proximity of developing teeth to the orbital floor. *Cr.gal.*, Crista galli; *Cel.eth.post.*, cellulæ ethmoidales posterior; *Proc.unc.*, posterior extremity of processus uncinatus; *S.max.*, sinus maxillaris; *C.inf.*, concha inferior; *N.infraorb.*, nervus infraorbitalis; *C.med.*, concha media; *C.sup.*, concha superior.

The concha inferior arises from a separate center which appears during the fifth month in the cartilage forming the lower portion of the nasal capsule.

The vomer is a membrane bone arising from two ossification centers which develop in the mesenchyme on each side of the posterorinferior border of the mesethmoid cartilage (Fig. 3). Two vertical bone plates develop and become united beneath the inferior margin of the septum, while superiorly they embrace the lower border of the septal cartilage (Figs. 4 and 5). The posterior portion of the cartilage thus invested ossifies, part undergoes a certain amount of re-

sorption, while the anterior portion persists as the cartilaginous septum of the nose (Fig. 18). Union between the two plates of the vomer is completed about the age of puberty. The groove on the anterosuperior margin of the vomer remains for the attachment of the vertical plate of the ethmoid and the septal cartilage.

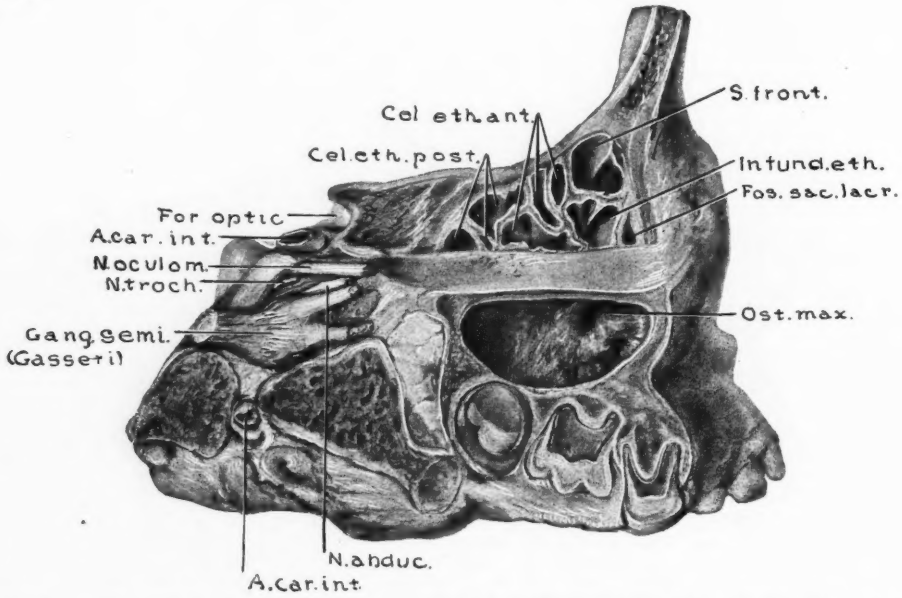

Fig. 14.—Specimen from a child one year, four months, and seven days old. Lateral view of frontal, ethmoidal, and maxillary sinus areas. (Series D, No. 14.)

S.front., Sinus frontalis developing from a frontal cell; *Infund.eth.*, infundibulum ethmoidale; *Fos.-sac.lacr.*, fossa sacci lacrimalis; *Ost.max.*, ostium maxillare; *N.abduc.*, nervus abducens; *A.car.int.*, arteria carotis interna; *Gang.semi.*, ganglion semilunare (Gasseri); *N.troch.*, nervus trochlearis; *N.oculom.*, nervus oculomotorius; *For.optic.*, foramen opticum; *Cel.eth.post.*, cellulæ ethmoidales posterior; *Cel.eth.ant.*, cellulæ ethmoidales anterior.

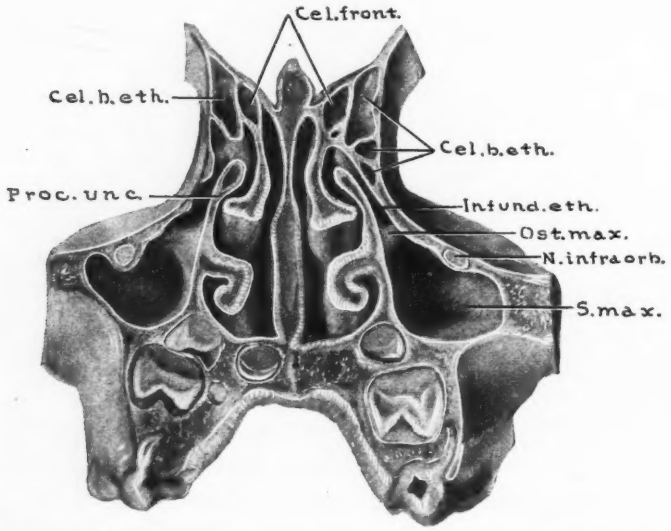

Fig. 15.—Specimen from a child four years, seven months, and nineteen days old. (Series D, No. 40.)

Anterior view of coronal section, cut 16 mm. posterior to the nasion, showing the lateral and superoinferior extent of the maxillary sinuses, their relations to developing teeth, and the relations of the ostium maxillare to the infundibulum ethmoidale. Note ridge beneath the right nervus infraorbitalis. The bullar cells have their ostia in the suprabullar furrow. The ostia of the cellulæ frontales are medial to the processus uncinatus and the bulla ethmoidalis. *Cel.front.*, Cellulæ frontales; *Cel.b.eth.*, cellulæ bulla ethmoidales; *Infund.eth.*, infundibulum ethmoidale; *Ost.max.*, ostium maxillare; *N.infraorb.*, nervus infraorbitalis; *S. max.*, sinus maxillaris; *Proc.unc.*, processus uncinatus.

The sphenoid bone arises from 14 centers of ossification which appear during the second and third fetal months. The basal portion of the cartilage ossifies to form two bones—the presphenoid and the basisphenoid—on each side of which centers develop for the orbitosphenoids (lesser wings) and alisphenoids (greater wings). An additional center appears on each side of the basisphenoid to form the lingula—which unites with the basisphenoid during the third month. In the sixth month the orbitosphenoids unite with the presphenoid. In the seventh month the presphenoid and basisphenoid unite, while fusion of the ali-

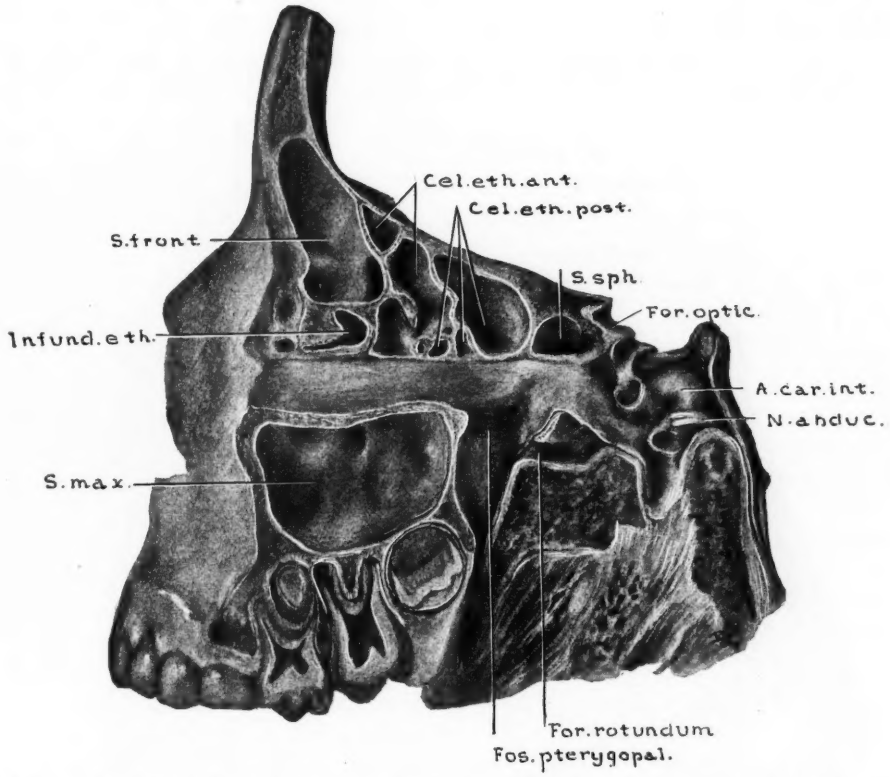

Fig. 16.—Specimen from a child five years, ten months, and twenty-two days old. Lateral view of frontal, ethmoidal, sphenoidal, and maxillary areas to show the extent of pneumatization present and the relation of the sinuses. (Series D, No. 45.)

Osseous wall, between sinus sphenoidalis and fossa pterygopalatina, is ½ mm. thick, while from sinus cavity to foramen rotundum is 1 mm. Sinus frontalis developed from an infundibular cell. *Cel.eth.-ant.*, Cellulæ ethmoidales anterior; *Cel.eth.post.*, cellulæ ethmoidales posterior; *S.sph.*, sinus sphenoidalis; *For.optic.*, foramen opticum; *A.car.int.*, arteria carotis interna; *N.abduc.*, nervus abducens; *For.rotundum*, foramen rotundum; *Fos.pterygopal.*, fossa pterygopalatina; *S.max.*, sinus maxillaris; *Infund.eth.*, infundibulum ethmoidale; *S.front.*, sinus frontalis.

sphenoids with the basisphenoid takes place shortly after birth. The centers which give rise to the alisphenoids extend into the external pterygoid plates.

The skull at birth (Fig. 9), when compared with the adult skull (Fig. 10), shows a marked difference in the relative proportions between the cranial and facial regions. It has been estimated that the volumes of the two portions have a ratio of 8:1 in a child at birth, 4:1 at five years of age and 2:1 in the adult skull (Froriep). These differences are chiefly due to the small vertical diameters of the maxillæ, the rudimentary condition of the alveolar borders of the maxillæ and mandible, and the small size of the nasal fossæ at birth. Increase in the diameters of the facial area is associated with the pneumatization of the

maxillæ, ethmoid, frontal and sphenoid bones. The extent of accessory sinus development in childhood has been underestimated by the vast majority of authors, the scarcity of anatomic material showing the conditions present during childhood being probably responsible for the erroneous conclusions.

So important is the role played by the accessory sinuses in the transformation of the bones of the infantile face into the adult type that we will consider their development separately. We find that all ethmoidal cells, the frontal and maxillary sinuses have their origin from preformed grooves or furrows between the folds which develop on the lateral nasal wall (Figs. 3, 4, and 5), while the sphenoidal sinus develops from the sphenoethmoidal recess (Fig. 7).

In embryos of thirty-eight to forty days, the concha nasalis inferior ap-

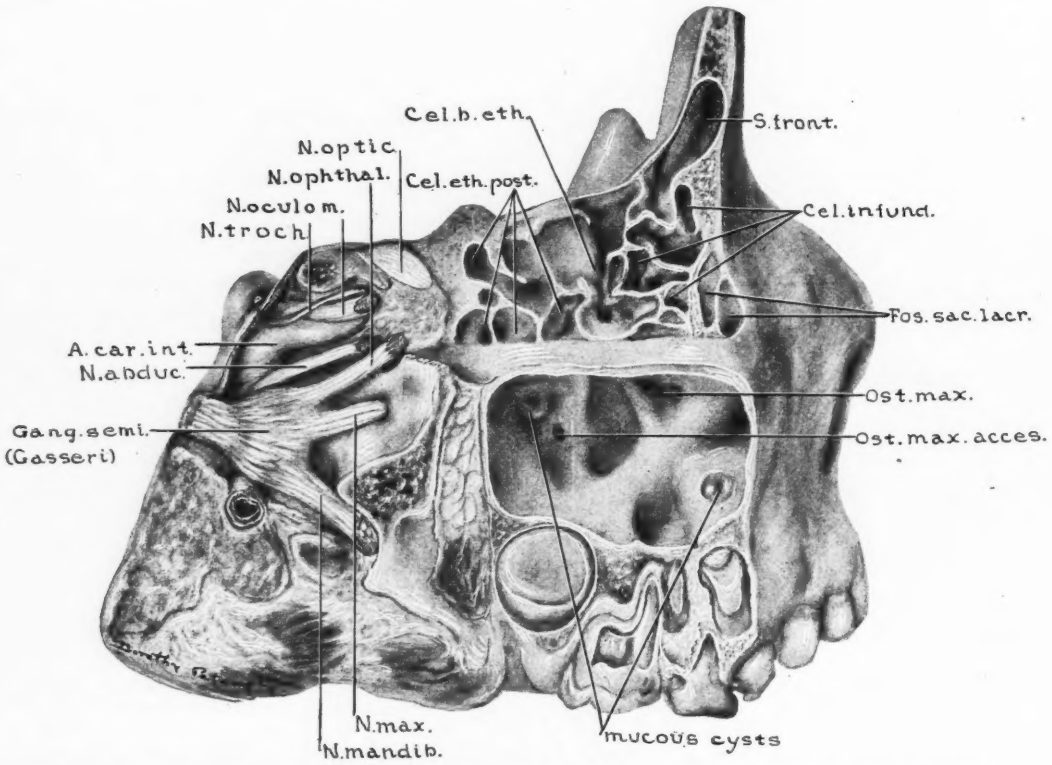

Fig. 17.—Specimen from a child six years, ten months, and twenty days old. By sagittal sections the lateral portions of the frontal, ethmoidal, and maxillary areas have been removed. (Series D, No. 53.)

The osseous ridges on the medial wall of the sinus maxillaris are unusually prominent. The largest one overlies the ductus nasolacrimalis. There were two lacrimal sacs present, the superior portion of the duct being bifid. Note presence of ostium maxillare accessorium and the proximity of the mucous cyst. *S.front.*, Sinus frontalis; *Cel.infund.*, cellulæ infundibulares; *Fos.sac.lacr.*, fossæ sacci lacrimales; *Ost.max.*, ostium maxillare; *Ost.max. acces.*, ostium maxillare accessorium; *N.max.*, nervus maxillaris; *N.mandib.*, nervus mandibularis; *Gang.semi.*, ganglion semilunare (Gasseri); *N.abduc.*, nervus abducens; *A.car.int.*, arteria carotis interna; *N.troch.*, nervus trochlearis; *N.oculom.*, nervus oculomotorius; *N.ophthal.*, nervus ophthalmicus; *N.optic.*, nervus opticus; *Cel.eth.post.*, cellulæ ethmoidales posterior; *Cel.b.eth.*, cellula bullæ ethmoidalis.

pears as a bulging of the inferior portion of the lateral nasal wall, immediately superior to the portion from which the palatal processes develop (Schaeffer). From the fortieth to the forty-third day the ethmoidal fold appears superior and slightly dorsal to the fold representing the concha inferior. From the ethmoidal fold, the ethmoidal conchæ develop as the nasal cavity increases in its superoinferior diameter (Figs. 3, 4, and 5). As the conchæ become more

prominent medially, there is also a lateral deepening of the grooves immediately beneath the conchæ, each groove becoming a meatus which is named in accordance with the concha beneath which it lies. In my series of 202 postnatal lateral nasal walls, four ethmoidal conchæ were present in 2 per cent of the cases, three in 92 per cent, and two in only 6 per cent, yet two is the number most frequently described in anatomic works. In one 188 day fetus five ethmoidal conchæ were demonstrable (Fig. 8).

In the latter part of the third month of intrauterine life, the conchæ nasales assume approximately their definitive outlines, and the meatuses become well marked. In the meatus medius two accessory folds, the processus uncinatus and the bulla ethmoidalis, are distinctly demonstrable (Figs. 4 and 5). During the fourth fetal month, the cellulæ ethmoidales develop as invaginations of the

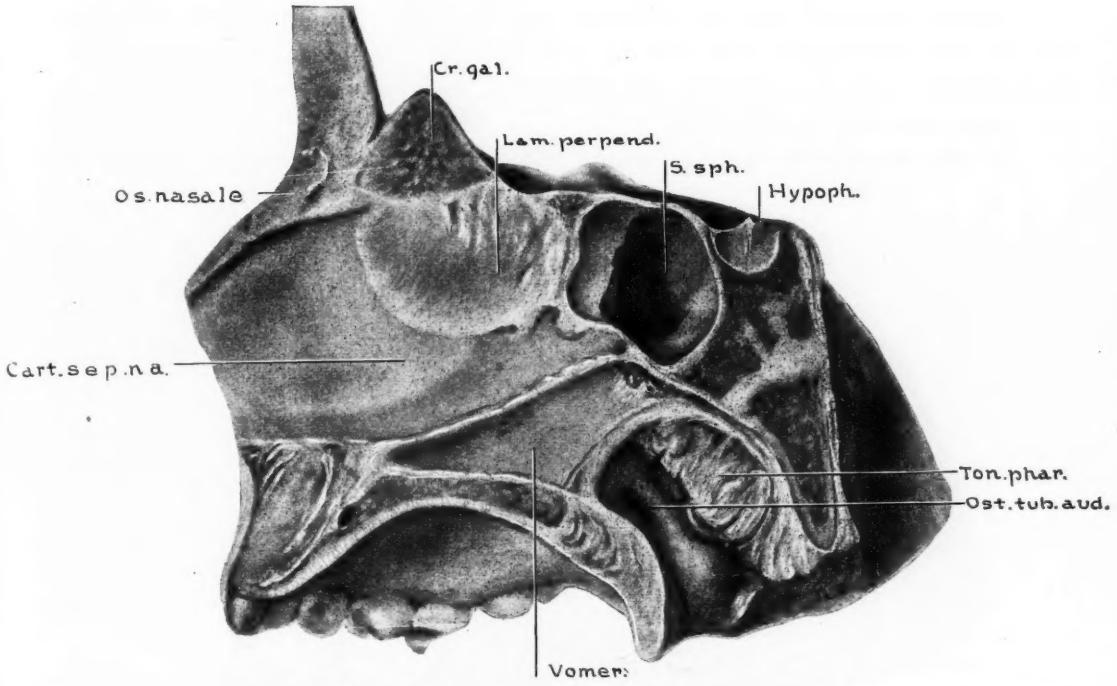

Fig. 18.—Specimen from a child six years, ten months, and twenty days old. Lateral view of this specimen is shown in Fig. 17. (Series D, No. 53.)

Sagittal section ½ mm. to the left of median line, showing extent of sinus sphenoidalis and also the relation of the structures entering into the formation of the septum nasi. *Cr.gal.*, Crista galli; *Lam.perpend.*, lamina perpendicularis; *S.sph.*, sinus sphenoidalis; *Hypoph.*, hypophysis; *Ton phar.*, tonsilla pharyngea; *Ost.tub.aud.*, ostium pharyngeum tubæ auditivæ; *Cart.sept.na.*, cartilago septi nasi.

nasal mucosa extending into the lateral masses of the ethmoid from the primitive grooves in the lateral nasal wall (Fig. 6). The invaginations are cylindric extensions of the mucosa, in which the epithelial surfaces are in contact, but, as their diameters increase, lumina develop within the cylindric processes, which by the sixth fetal month usually show distinct cell formation.

Ethmoid cells are best classified into anterior and posterior groups. All ethmoidal cells having their ostia inferior to the attachment of the concha nasalis media belong to the anterior group, while those having their ostia superior to the concha media belong to the posterior group (Fig. 23). This classification holds good regardless of how far the more distant portions of any ir-

regularly developed cells of either group may invade the region ordinarily occupied by cells of the other group.

Each group is subdivided as follows:

Cellulæ ethmoidales anterior	Cellulæ frontales. Cellulæ infundibulares. Cellulæ bullæ ethmoidales.
Cellulæ ethmoidales posterior	Cells communicating with the meatus superior. Cells communicating with the meatus supremus I. Cells communicating with the meatus supremus II.

Seydel observed that an ethmoid cell having its origin from any given meatus, did not communicate with any cell having origin from any other meatus. Zuckerkandl took exception to this statement, but certainly every specimen in my series supports Seydel's view.

On the superior portion of the anterolateral wall of the recessus chonchalis,

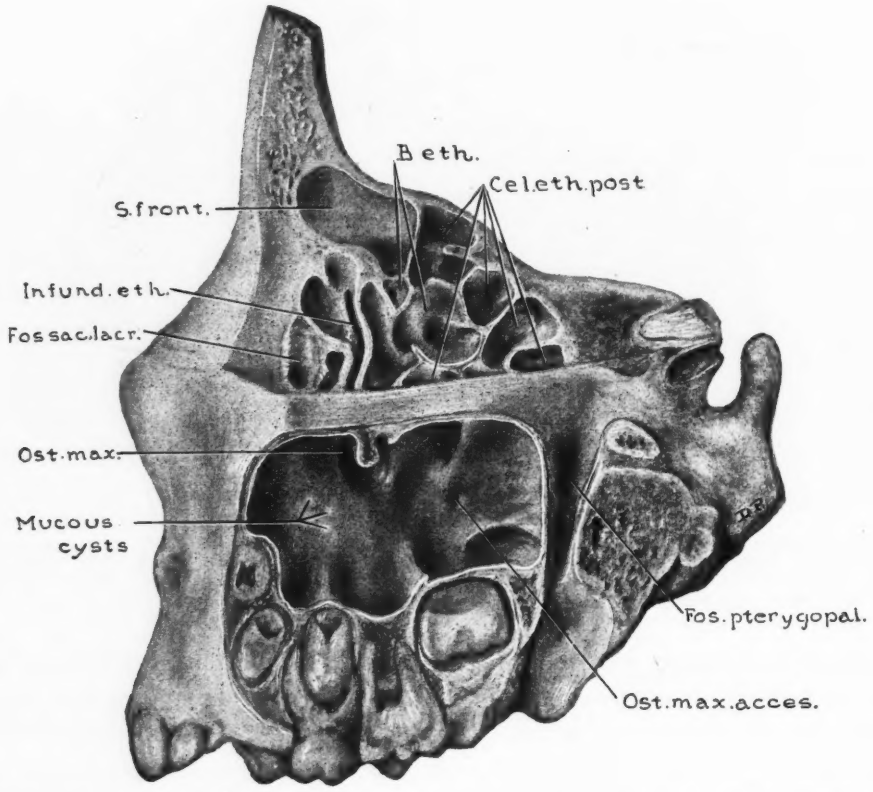

Fig. 19.—Specimen from a child eight years, two months, and ten days old. (Series D, No. 59.)

Lateral view of frontal, ethmoidal, and maxillary areas. Note that the sinus frontalis developed from a cell having its origin from the suprabullar furrow. The right sinus frontalis had a similar origin, these two being the only such instances found in the entire series. The supero-inferior extent of the cellulæ ethmoidales is in this case greater than usually found at this age. *B.eth.*, Cellulæ bullæ ethmoidales; *Cel.eth. post.*, cellulæ ethmoidales posterior; *Fos.pterygopal.*, fossa pterygopalatina; *Ost.max.acces.*, ostium maxillare accessorium; *Ost.max.*, ostium maxillare; *Fos.sac.lacr.*, fossa sacci lacrimalis; *Infund.eth.*, infundibulum ethmoidale; *S.front.*, sinus frontalis.

a large majority of late fetal and early childhood specimens show from one to three small ridges developing from the posteromedial surface of the processus frontalis of the maxilla. These ridges are the conchæ frontales (Fig. 21), and from the furrows or depressions between them, or between them and the surrounding walls of the recess, the celluæ frontales develop. The infundibulum ethmoidale is a gutter-like groove lying lateral to the processus uncinatus (Figs. 4, 15, and 27). Infundibular cells develop as extensions from the infundibulum (Figs. 4 and 15). Bullar cells develop in the bulla ethmoidalis, as extensions from the suprabullar furrow (81.7 per cent) or from the infrabullar furrow (19.3 per cent).

The manner in which the processus uncinatus is attached to the agger nasi

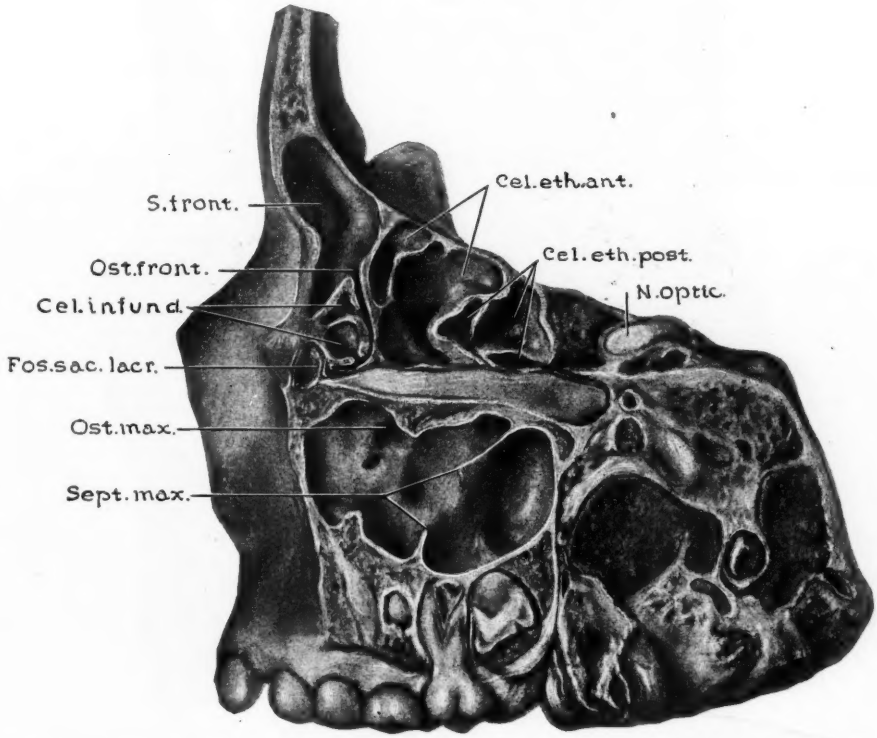

Fig. 20.—Specimen from a child eight years, eight months, and one day old. (Series D, No. 63.)

Lateral view of frontal, ethmoidal, and maxillary sinus areas, the lateral portion of each having been removed by sagittal cuts. Note that the sinus frontalis developed directly from the infundibulum ethmoidale. Note also the incomplete septa in the sinus maxillaris. *Cel.eth.ant.*, Cellulæ ethmoidales anterior; *Cel.eth.post.*, cellulæ ethmoidales posterior; *N.optic.*, nervus opticus; *Sept.max.*, septulæ maxillares; *Ost.max.*, ostium maxillare; *Fos.sac.lacr.*, Fossa sacci lacrimalis; *Cel.infund.*, cellulæ infundibulares; *Ost. front.*, ostium frontale; *S.front.*, sinus frontalis.

and the character of the attachment of the anterior portion of the concha media exert the greatest influence upon the proportion between the number and size of the frontal and infundibular cells. If the processus uncinatus is attached to the posterolateral portion of the agger nasi and the anterosuperior attachment of the concha media is high up on the lateral nasal wall, then the frontal cells are apt to be well developed (Fig. 21). However, if the anterior attachment of the processus uncinatus is more medial in position, and the anterosuperior attachment of the concha media is situated lower on the lateral nasal wall, then the frontal recess is small and the frontal cells are apt to be deficient in de-

velopment, and there is usually a corresponding increase in both the number and the extent of development of the infundibular cells (Figs. 17 and 24).

These variations are important because of the influence which they have on the development of the frontal sinus, which always has its origin from the anterior ethmoidal area. In 202 cases the following were the five ways in which development of the sinus frontalis occurred and the percentage of each variety:

1. By the extension of one of the cellulæ frontales, 41 per cent (Fig. 23).

2. By the extension of the recessus conchalis, no cellulæ frontales being demonstrable, 18.4 per cent.

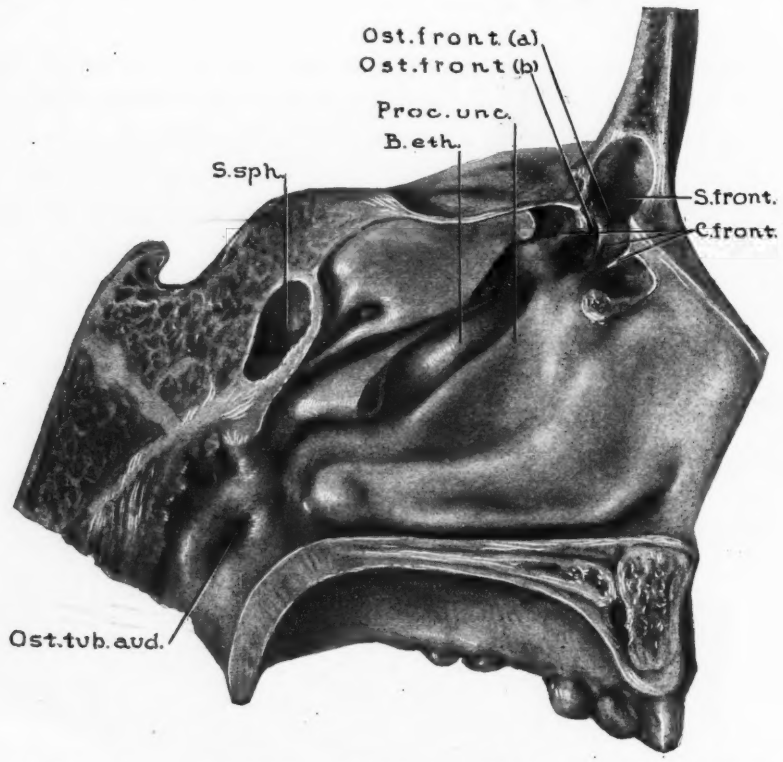

Fig. 21.—Specimen from a child nine years, one month, and nine days old. (Series D, No. 64.)

Incision through maxilla is ½ mm. to the right of median line; in the frontal region 1 mm. to the left, and through the body of the sphenoid is 5 mm. to the left of median line. The anterior portion of the concha media and a small portion of the frontal bone have been removed to show the structures entering into the formation of the lateral nasal wall, and also the location of the ostia frontalia. In this case there are three sinus frontales—one in the right side and the two in the left side here illustrated. Of the more lateral sinus frontalis, only the ostium is shown (*Ost.front.(b)*; the sinus, however, extends to the same height as the medial one shown in the illustration. Note that neither ostium comes into direct relation to the infundibulum ethmoidales. In the suprabullar furrow ostia of bullar cells are shown. *S.front.*, Sinus frontalis; *C.front.*, conchæ frontales; *Ost.tub.aud.*, ostium pharyngeum tubæ auditivæ; *S.sph.*, sinus sphenoidalis; *B.eth.*, bulla ethmoidalis; *Proc.unc.*, processus uncinatus; *Ost.front.(b)*, ostium of the lateral sinus frontalis; *Ost.front.(a)*, ostium of the medial sinus frontalis.

3. By the extension of a cellula ethmoidalis anterior having its origin from the suprabullar furrow, 1 per cent (Fig. 19).

4. By direct extension of the infundibulum ethmoidale, 15.6 per cent (Fig. 20).

5. By the extension of one of the cellulæ infundibulares, 24 per cent (Figs. 16 and 29).

Thus we find that sinus frontales developing by the first three methods, a

total of 60.4 per cent, of the cases in my series, communicate with the meatus medius without communicating with the infundibulum ethmoidale. Sinuses which develop by the fourth and fifth methods, however,—a total of 39.6 per cent, of the cases—communicate with the meatus medius via the infundibulum and the hiatus semilunaris. In the latter cases there is thus a closer relationship between the sinus frontales and the sinus maxillares, since the ostium maxillare in all cases is situated in the inferolateral wall of the infundibulum.

Ordinarily only one frontal sinus develops on each side (Fig. 22), but in a few instances (3.5 per cent, in this series), supernumerary sinuses are found

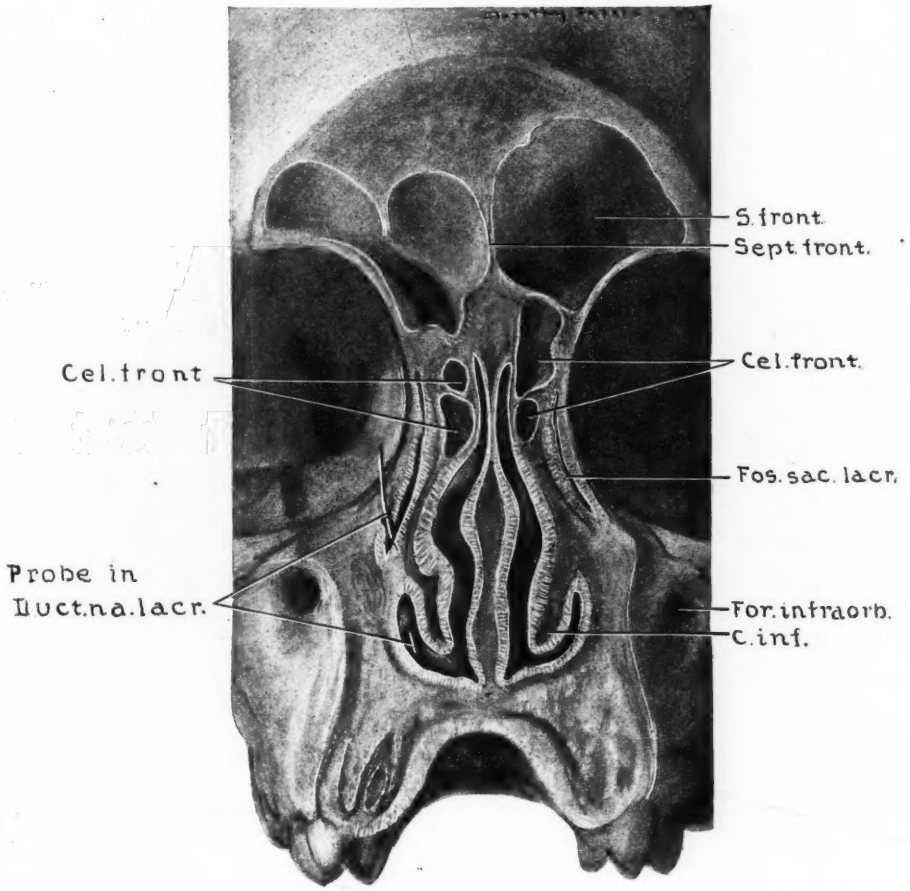

Fig. 22.—Specimen from a child twelve years, nine months, and twelve days old. (Series D, No. 69.)

Anterior view of a coronal section cut 12 mm. posterior to the nasion, to show superior and lateral extent of the sinus frontales, also the relations of the cellulæ frontales. The frontal sinuses and all cells shown in this illustration have their ostia medial to the uncinate processes. Note the relations of the ductus nasolacrimalis. *S.front.*, Sinus frontalis; *Sept.front.*, septum frontale; *Cel.front.*, cellulæ frontales; *Fos. sac.lacr.*, fossa sacci lacrimalis; *For.infraorb.*, foramen infraorbitalis; *Duct.na.lacr.*, ductus nasolacrimalis.

(Fig. 27). Supernumerary sinus frontales may develop from two cellulæ infundibulares, from two cellulæ frontales, or from any combination of the above described five routes of development of single sinuses.

Although distinct cellulæ ethmoidales anterior are demonstrable during the latter months of fetal life, yet, in the average case, one can not say definitely which of the extending processes of pneumatization represents the primitive sinus frontalis until after the sixth month of postnatal life. In some specimens

the probable route of development can be determined with a fair degree of certainty at the time of birth or shortly thereafter (Fig. 12) while in other cases the distinct beginning of a sinus frontalis is not demonstrable until near the end of the first year (Fig. 14). From whichever of these sources a frontal sinus may have its origin, the process of pneumatization gradually extends from that portion of the anterior ethmoidal area toward and into the inferior portion of the frontal bone (Fig. 16). The sinus, surrounded as it is by a thin lamina of compact bone, then advances toward the ascending portion of the frontal bone, advancing as the cancellous bone is resorbed. In an average case, the sinus be-

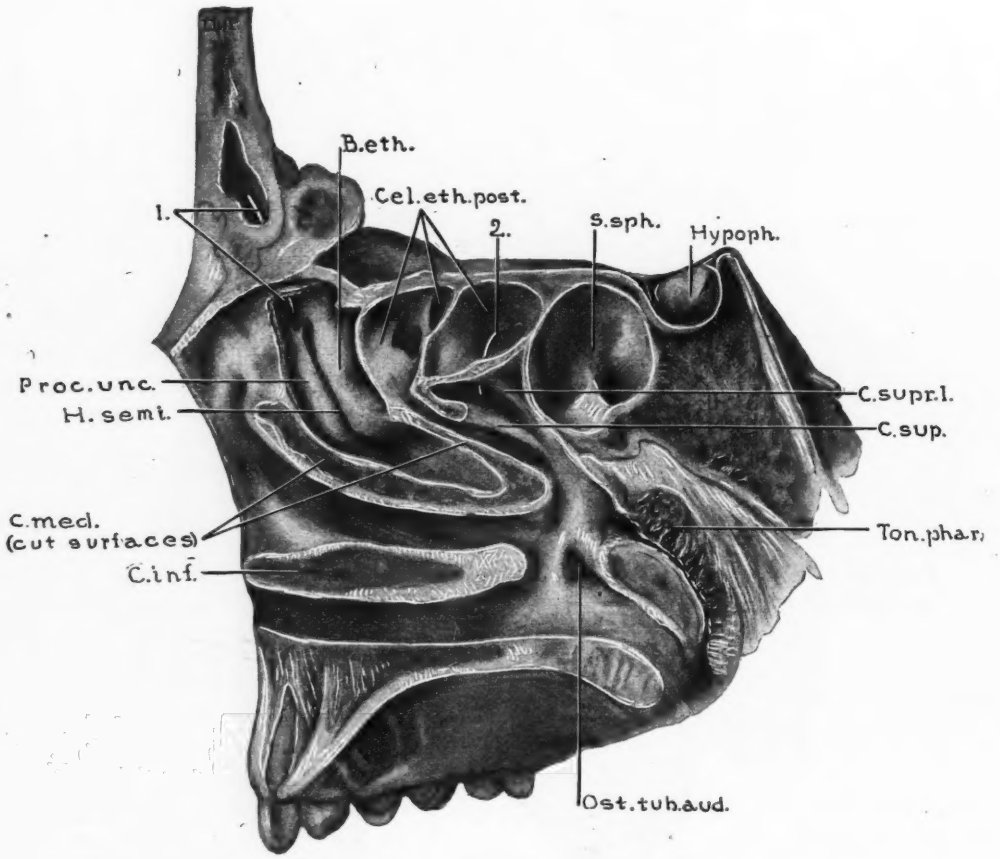

Fig. 23.—Specimen fourteen years and seven months old. (Series D, No. 73.)

Sagittal section, cut 4 mm. to the right of the median line, thus removing the medial portions of the concha inferior and concha media, and the medial anterosuperior portions of the concha superior and concha suprema I. The relations of the structures forming the lateral nasal wall and the positions of the ostia of the cellulæ ethmoidales are thus clearly shown. *1.*, Probe through ostium frontale; *B.eth.*, bulla ethmoidalis; *Cel.eth.post.*, cellulæ ethmoidales posterior; *2.*, probe through ostium of most posterior ethmoidal cell; *S.sph.*, sinus sphenoidalis; *Hypoph.*, hypophysis; *C.supr.I*, concha suprema I; *C.sup.*, concha superior; *Ton.phar.*, tonsilla pharyngea; *Ost.tub.aud.*, ostium pharyngeum tubæ auditivæ; *C.inf.*, concha inferior; *C.med.*, concha media; *H.semi.*, hiatus semilunaris; *Proc.unc.*, processus uncinatus.

gins its ascent into the vertical portion of the bone during the second year. As the sinus advances into the vertical portion of the bone, its posterior wall is always thin and consists almost entirely of compact bone, while the anterior wall, as found in different specimens, varies greatly in its thickness and usually contains a considerable amount of diploë. The sinuses of the two sides are seldom quite symmetric, though the general outline often suggests an attempt at sym-

metry. Not uncommonly, however, the two sinuses are of an entirely different form. The degree of supraorbital or superciliary prominence can not be taken as an indication of the size of the sinuses to be found beneath them. The adult sinus shows marked irregularity, varying from the form which fails to reach the level of the supraorbital margins to the form extending far above the superciliary ridge and laterally over the entire supraorbital area. An average sinus

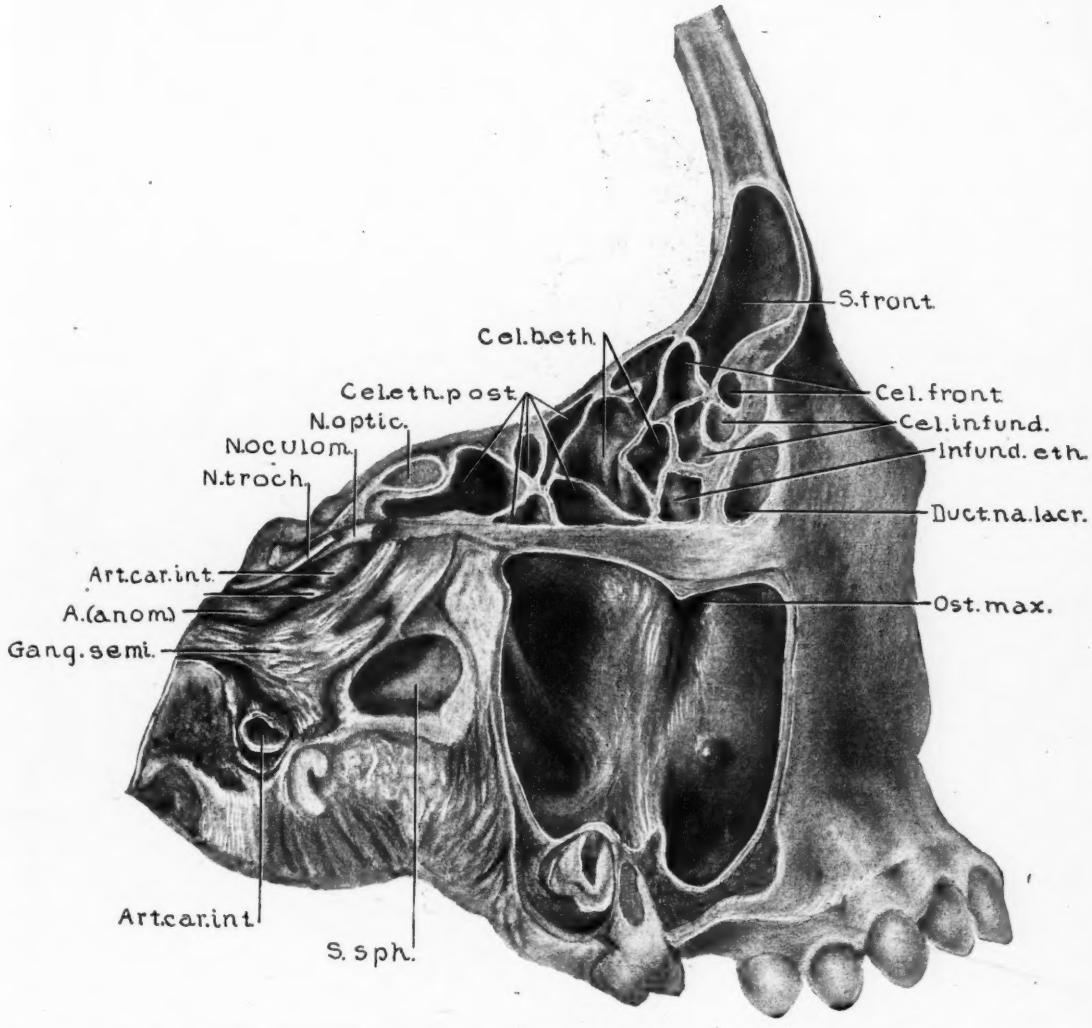

Fig. 24.—Specimen fifteen years, nine months, and twenty-six days old. (Series D, No. 76.)

Lateral portions of the frontal, ethmoid, maxillary, and sphenoidal areas have been removed by sagittal incisions. Note the marked extent of the sinus sphenoidalis into the pterygoid process. The ridge which is seen on the floor of the sinus sphenoidalis overlies the nervus canalis pterygoidei (Vidii). The sinus maxillaris extends 11 mm. below the level of the nasal floor. *S.front.*, Sinus frontalis; *Cel.front.*, cellulæ frontales; *Cel.infund.*, cellulæ infundibulares; *Infund.eth.*, infundibulum ethmoidale; *Duct.na.lacr.*, ductus nasolacrimalis; Ost.max., ostium maxillare; *S.sph.*, the portion of sinus sphenoidalis extending into the pterygoid area; *Art.car.int.*, arteria carotis interna; *Gang.semi.*, ganglion semilunare; *A.anom.*, anomalous branch of carotid artery; *N.troch.*, nervus trochlearis; *N.oculom.*, nervus oculomotorius; *N. optic.*, nervus opticus; *Cel.eth.post.*, cellulæ ethmoidales posterior; *Cel.b.eth.*, cellulæ bullæ ethmoidales.

frontalis extends laterally to a point just medial to the supraorbital notch, and superiorly to the lower border of the superciliary ridge.

Beginning development of the sinus sphenoidalis is demonstrable in sixty-five-day embryos as an invagination of the mucosa in the recessus sphenoeth-

moidalis extending into the posterior portion of the cartilaginous nasal capsule, the advancement of the pouching process being in a posteroinferior and slightly lateral direction. The primitive sphenoidal sinuses thus come to lie posterior to the nasal capsule and anterolateral to the body of the sphenoid bone. In the anteroinferior wall of the primitive sinus there develops an ossification center for the concha sphenoidalis, or ossiculum Bertini (Fig. 7), ossification of which is well advanced in term fetuses, but it does not become firmly attached to the body of the sphenoid until the second or third year.

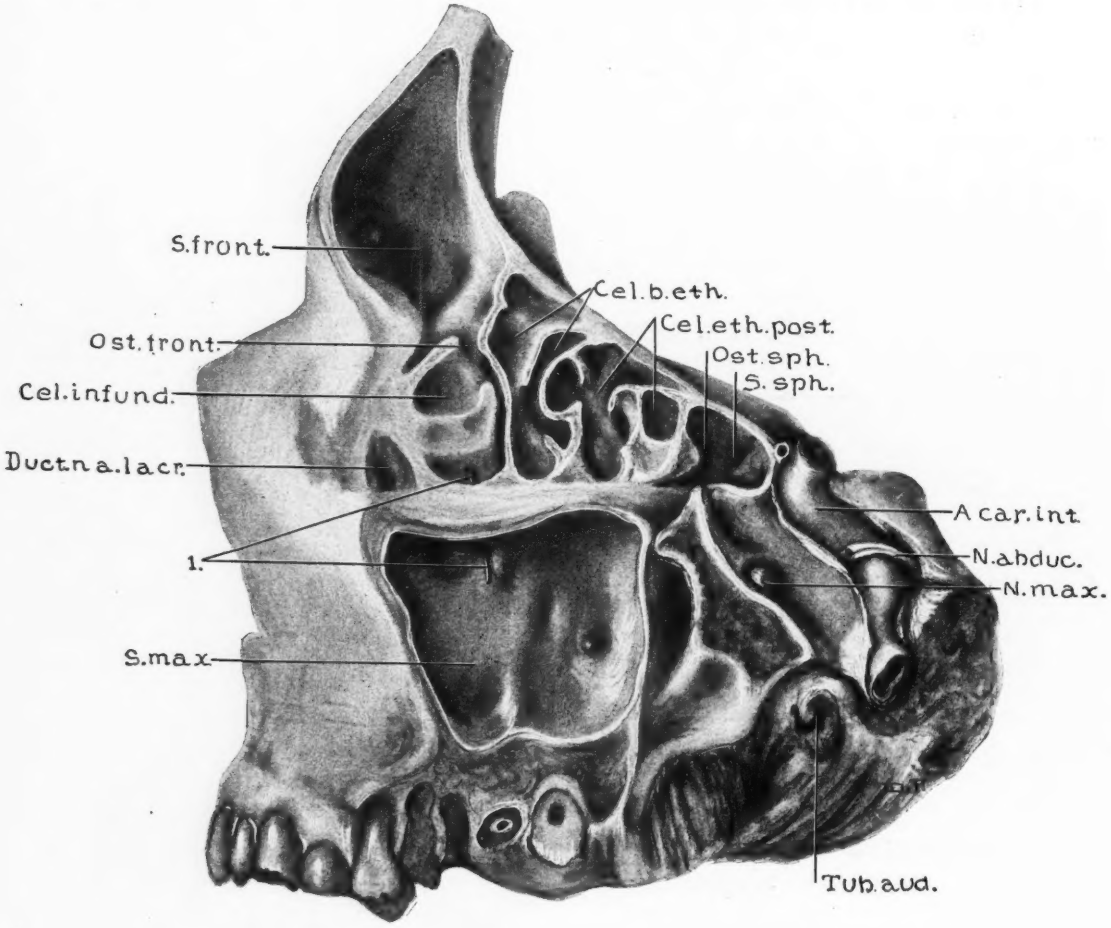

Fig. 25.—Specimen, eighteen years, eleven months, and ten days old. (Series D, No. 85.)

Lateral view of the frontal, ethmoidal, maxillary, and a portion of the sphenoidal areas. Sinus frontalis developed from an infundibular cell. Note that the ostium frontale is not in the most inferior portion of the floor of the sinus. *Cel.b.eth.*, Cellulæ bullæ ethmoidales; *Cel.eth.post.*, cellulæ ethmoidales posterior; *Ost.sph.*, ostium sphenoidale; *S.sph.*, sinus sphenoidalis; *A.car.int.*, arteria carotis interna; *N.abduc.*, nervus abducens; *N.max.*, nervus maxillaris; *Tub.aud.*, tuba auditiva (Eustachii); *S.max.*, sinus maxillaris; *1*, probe through ostium maxillare; *Duct.na.lacr.*, ductus nasolacrimalis; *Cel.infund.*, cellula infundibularis; *Ost.front.*, ostium frontale; *S.front.*, sinus frontalis.

The extent of sphenoidal pneumatization is more irregular than that of any other accessory sinuses, showing wider variations in specimens of approximately the same age. In average cases the rate of development is such that by the eighth to tenth year the posterosuperior portion of the sinus lies beneath the anterior portion of the sella turcica (Fig. 18), and by the fifteenth year is usually separated from the hypophysis by a very thin lamina of compact bone. An-

terosuperiorly, the sinus is in close relation to the most posterior of the ethmoid cells, but in no case is there a direct communication between the sinus and such cells (Figs. 16 and 25). In many instances the sinuses not only fill the body of the sphenoid, but may extend far into the clivus, into the pterygoid processes (Fig. 24), into the greater or lesser wings of the sphenoid, or in some instances into the orbital process of the palate bone. The sphenoidal septum is always

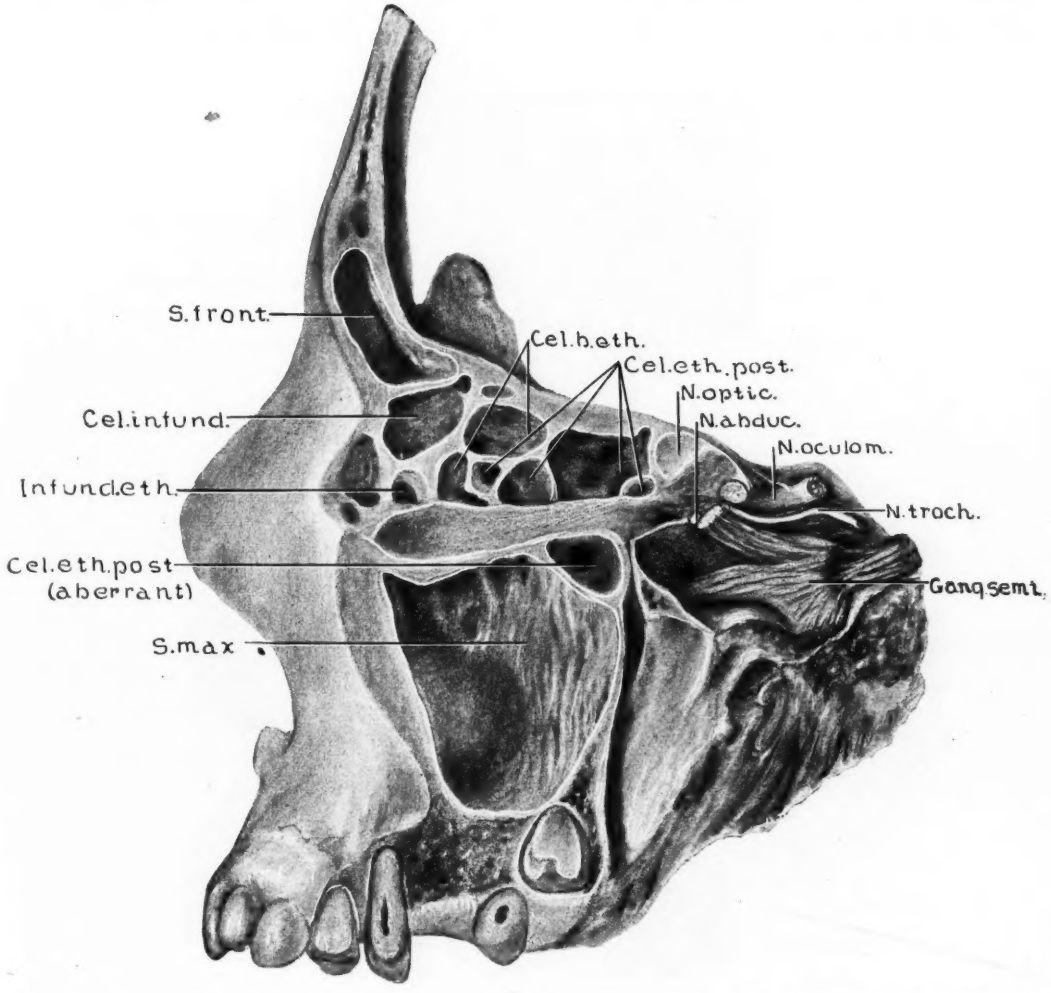

Fig. 26.—Specimen nineteen years and twenty-eight days old. Lateral view of frontal, ethmoidal, and maxillary areas. (Series D, No. 86.)

Note presence of an aberrant ethmoidal cell which has invaded the postero-superior portion of the maxilla. The ostium of this cell is in the midportion of the lateral wall of the meatus superior. When this type of development is more extensive, a "double maxillary sinus" is formed, as described by Zuckerkandl. *Cel.b.eth.*, Cellulæ bullæ ethmoidales; *Cel.eth.post.*, cellulæ ethmoidales posterior; *N.optic.*, nervus opticus; *N.abduc.*, nervus abducens; *N.oculom.*, nervus oculomotorius; *N.troch.*, nervus trochlearis; *Gang. semi.*, ganglion semilunare; *S.max.*, sinus maxillaris; *Cel.eth.post.*, (aberrant), aberrant cellula ethmoidalis posterior; *Infund.eth.*, infundibulum ethmoidale; *Cel.infund.*, cellula infundibularis; *S.front.*, sinus frontalis.

complete, but is seldom medial in position, due to irregularities in the rate of resorption in the developing sinuses of the two sides.

The sinus maxillaris is the most constant of the nasal accessory sinuses, and the extent of its development is also the most regular, as is shown by comparing the tables of measurements given by the different observers.

In embryos eighty-five days old, the primitive sinus maxillaris appears as

a lateral outpouching of mucosa from the inferolateral wall of the infundibulum ethmoidale, slightly anterior to its midpoint anteroposteriorly. This point of primary lateral pouching persists as the ostium maxillare, while by the combined processes of resorption and expansion the sinus comes to occupy the greater part of the body of the maxilla. In early childhood the general outline of the sinus is rather ovoidal (Figs. 12 and 14), but after the fifth year it gradually changes into a quadrilateral pyramidal form which persists and becomes more pronounced as the usual adult type (Figs. 16, 17, 19, 24, and 25).

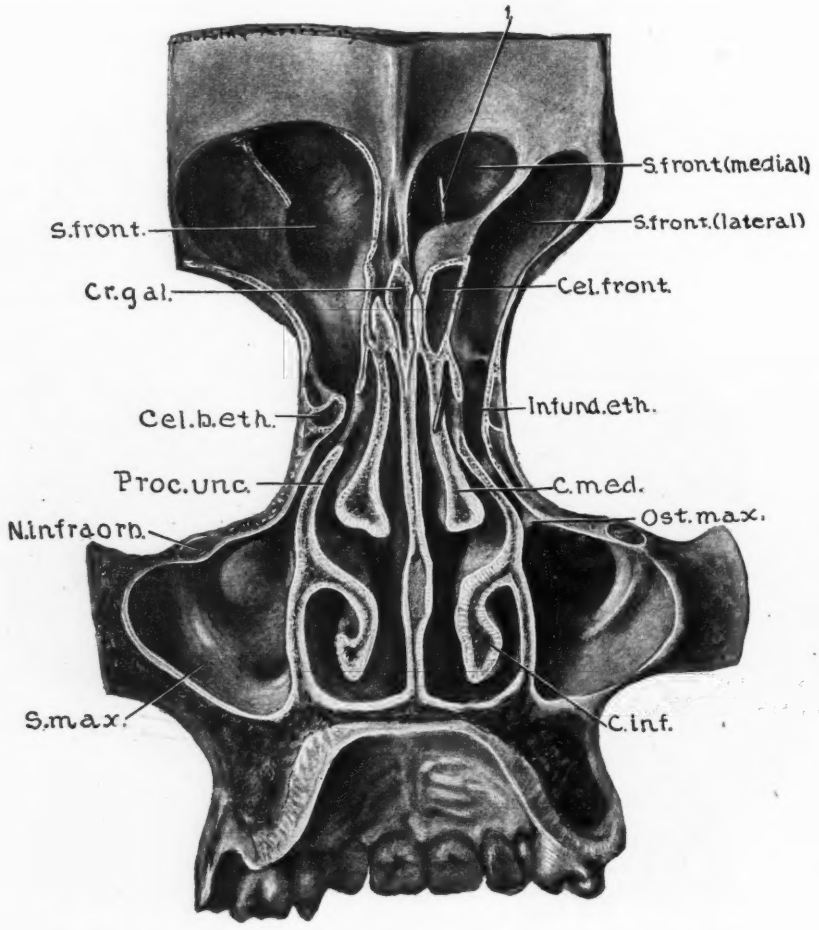

Fig. 27.—Specimen twenty years and five months old. (Series D, No. 90.)

Posterior view of a coronal section 18 mm. posterior to the nasion. The posterior walls of the sinus have been removed to show the relations of the sinuses and their ostia. Note that on the right side there are two distinct sinus frontales present. The more medial of these two sinuses developed from a cellula frontalis, medial to the processus uncinatus, while the lateral one developed from the infundibulum. *1*, Probe through the ostium of the medial sinus frontalis, the ostium being anterior to the cellula frontalis shown in illustration; *S.front.*, sinus frontalis; *Cel.front.*, cellula frontalis; *Infund.eth.*, infundibulum ethmoidale; *C.med.*, concha media; *Ost.max.*, ostium maxillare; *C.inf.*, concha inferior; *S.max.*, sinus maxillaris; *N.infraorb.*, nervus infraorbitalis; *Proc.unc.*, processus uncinatus; *B.eth.*, bulla ethmoidalis (extreme anterior portion); *Cr.gal.*, crista galli.

In a child eight days old (Fig. 12), the sinus diameters were 8.2 mm. anteroposteriorly, 3.3 mm. vertically, and 2.8 mm. laterally. Up until the eighth year the diameters of the sinus maxillaris increase at a rate which was found to average approximately 2 mm. each year in both the vertical and the lateral diameters, and 3 mm. anteroposteriorly. After the eighth year the development

advances more slowly in all directions, reaching in the fifteenth to the eighteenth year a form which approximates the adult type, later changes being shown chiefly in the posteroinferior angle, which descends as the third molar tooth erupts. The floor of the sinus maxillaris, in an average case, reaches a level equal to that of the floor of the nasal fossa during the eighth year, and in the majority of cases thereafter is from 1 mm. to 5.5 mm. below the level of the nasal floor.

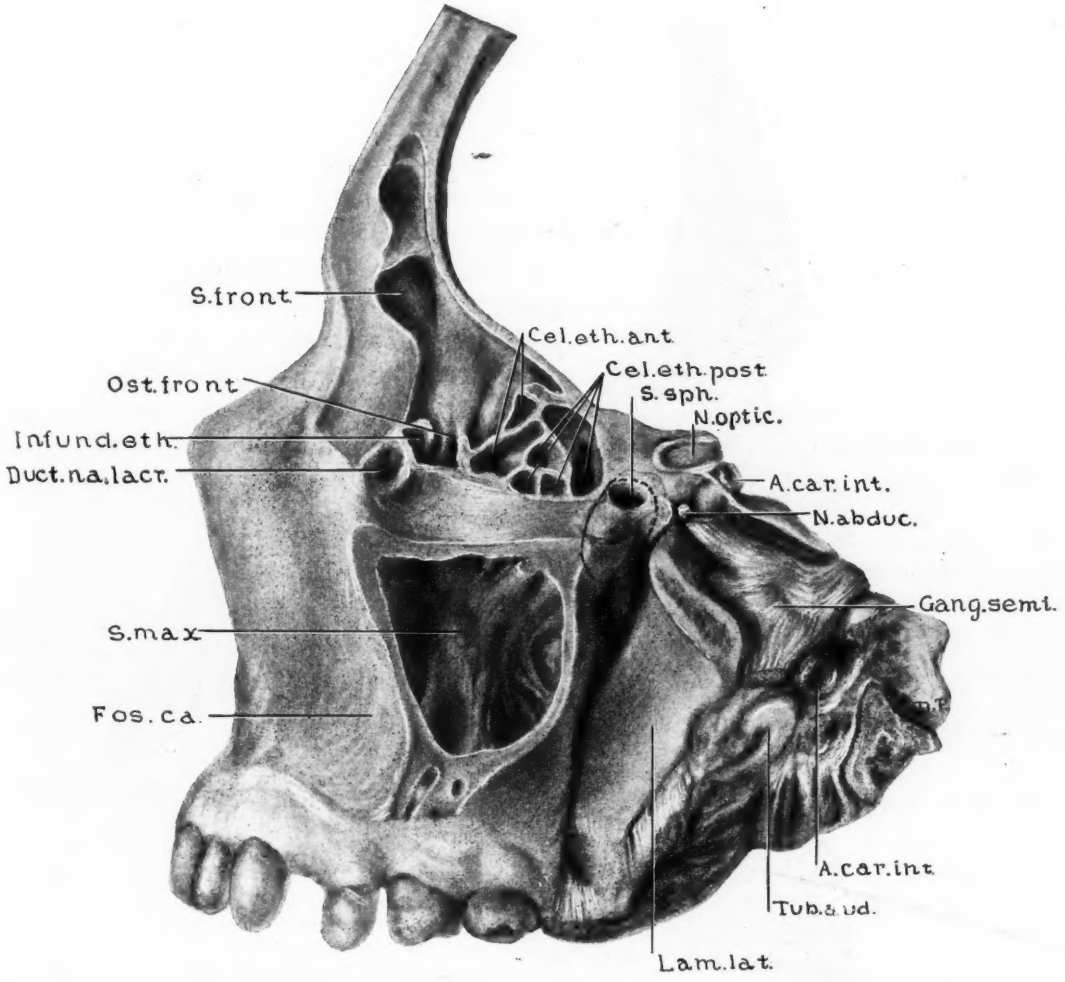

Fig. 28.—Specimen twenty-three years, seven months, and thirteen days old. Lateral view of frontal, ethmoidal, maxillary, and a portion of the sphenoidal areas. (Series D, No. 94.)

The dotted line outlines the extent of the sinus sphenoidalis. The sinus sphenoidalis and the sinus maxillaris are both unusually small for an adult. (Compare with preceding figures.) Note also the unusually large fossa canina. The sinus frontalis developed from an infundibular cell. *Cel.eth.ant.*, Cellulæ ethmoidales anterior; *Cel.eth.post.*, cellulæ ethmoidales posterior; *S.sph.*, sinus sphenoidalis; *N.optic.*, nervus opticus; *A.car.int.*, arteria carotis interna; *N.abduc.*, nervus abducens; *Gang.semi.*, ganglion semilunare; *Tub.aud.*, tuba auditiva; *Lam.lat.*, lamina lateralis processus pterygoidei; *Fos.ca.*, fossa canina; *Duct.na.lacr.*, ductus nasolacrimalis; *Infund.eth.*, infundibulum ethmoidale; *Ost.front.*, ostium frontale; *S.front.*, sinus frontalis.

In the development of the maxillary sinus (also in ethmoidal, frontal and sphenoidal sinuses), the pouching mucosa rests upon a layer of compact bone as the process of pneumatization extends into the body of the bone, the layer of compact bone advancing as the resorption goes on in the underlying cancellous bone. The floor of the sinus maxillaris, in all stages of its development, is in

close relation to the teeth (Figs. 12, 16, and 19), and the increase in the vertical diameter of the sinus is found to be much more of a process of expansion as the body of the maxilla increases in size, than it is one of resorption of cancellous bone previously occupying the area.

The number of teeth, the roots of which are in close relation to the floor of the sinus, shows marked variations. However, the typical floor may be considered as one which overlies the roots of all the molars and the posterior por-

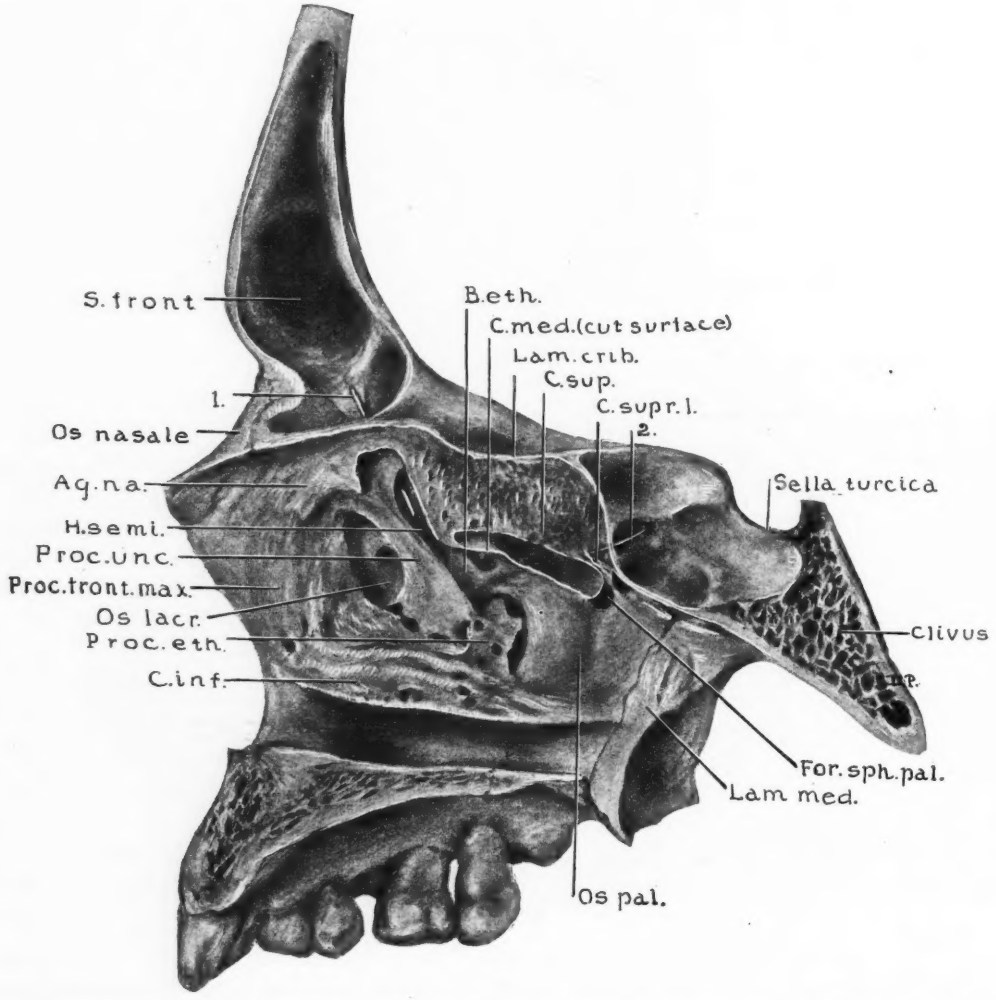

Fig. 29.—Specimen thirty-five years old. Sagittal section from which the soft parts had been removed by maceration. (Series E, No. 5.)

Concha nasalis media has been removed to allow a better view of the processus uncinatus and the bulla ethmoidalis. The sinus frontalis developed from an infundibular cell. *1.*, Probe through ostium frontale; *2.*, probe through ostium sphenoidale; *B.eth.*, bulla ethmoidalis; *C.med.*, concha media (cut surface); *Lam.crib.*, lamina cribrosa; *C.sup.*, concha superior; *C.supr.1*, concha suprema 1; *For.sph.pal.*, foramen sphenopalatinum; *Lam.med.*, lamina medialis processus pterygoidei; *Os pal.*, pars perpendicularis ossis palatina; *C.inf.*, concha inferior; *Proc.eth.*, processus ethmoidalis conchæ nasalis inferior; *Os lacr.*, os lacrimal; *Proc.front.max.*, processus frontalis maxillæ; *Proc.unc.*, processus uncinatus; *H.semi.*, hiatus semilunaris; *Ag.na.*, agger nasi; *S.front.*, sinus frontalis.

tion of the second premolar. In many cases only the molars come into close relation, and in a few cases only the second and third molars are directly beneath the floor. It is a very extensive floor, which advances so far anteriorly as to overlie the first premolar, and in my series no case was found in which the root

of the canine was in relation to the floor. In a few of the largest sinuses, however, the root of the canine extended well up into the anterior wall of the sinus.

Regardless of the extent of the irregularities in the floor of the sinus produced by resorption of the cancellous bone surrounding the roots of the teeth, in no instance was the mucosa lining the sinus found in direct contact with the root of a healthy tooth. In all normal cases a thin layer of compact bone is present between the roots of the teeth and the mucosa, but in some instances where there has been abscess formation at the root of a tooth, this intervening plate of bone may be destroyed, thus allowing the root to project into the sinus cavity in direct contact with the overlying mucosa.

Besides the recesses produced by the irregularities on the alveolar surface (Fig. 20), pockets may be formed by osseous projections on the anterior, or less frequently, on the posterior wall. Such ridges may, in rare instances, extend sufficiently far toward the central portion of the sinus as to form incomplete septa or septulæ. Such formations have no embryologic significance and are entirely due to irregularities in the process of resorption. Ridges and folds of any of these varieties probably assume an important role only in the presence of suppurative conditions within the sinus, when the recesses or pockets make the thorough cleansing of the cavity more difficult.

Changes in the facial bones in old age are those incident to the loss of teeth and the absorption of the alveolar processes, and the general thinning of the bone Fig. 11). The angle of the mandible also becomes more obtuse, sometimes to an extent suggestive of its original form in infancy.

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DISCUSSION.

Dr. Cryer.—Mr. President and Members of the American Society of Orthodontists: I do not know when I have listened to a Paper from beginning to end in which I have been so interested as in this one by Dr. Davis. You all know that I have been working along similar lines for twenty-five or thirty years. Many of my sections of bone you are acquainted with. The greater portion of Dr. Davis' paper is indiscussible. It is a matter of facts he has given us, and you can not discuss facts. Some of the variations he has shown us, for instance of the maxillary and sphenoidal sinus, also the double osteum maxillare, are found in the specimens he has made. If our friend here, the President of this Society, had another lot of bones and was looking for variations, he would probably get other types. If I should drop all I have ever done and take up another lot of bones, I would find still others, so it depends on the specimens that each investigator obtains.

I am going to ask you the privilege of showing a few slides. Many of them you are acquainted with. In a little book written nearly twenty years ago I mentioned there were no two sphenoid bones alike: that if you made a complete picture of one thousand of these bones, the composite would be accepted as the typical sphenoid, but I doubt if you could find one. I also said that not only do variations exist in different skulls, but in the same skull the maxillary sinus on one side would be different from that sinus on the other side. Adami has gone even further than that and says there are no two cells alike.

The following slides are made from actual photographs. The nasal conchæ, turbinate scrolls, are well described by Dr. Davis. He gives certain variations as to the number of the concha, consequently the number of the meati will vary accordingly. Zuckerkandl stated that 6.7 per cent of the skulls examined by him had four meati. In skulls I examined I found as high as 60 per cent with four meati, some even had five, while one had six.

Slide 1—Two photographs showing relative sizes, photographed on the same plate. They show the outer walls of the nasal cavities, giving the variation, size and shape of the concha, consequently the shape and number of the meati as described by Dr. Davis.

Dr. Davis showed very nicely a developing vomer with two, right and left parts. Slide 2 is an x-ray picture of an adult skull, it plainly shows the two, right and left plates of the vomer with the space between them. This space between the plates of the vomer might, a few years ago, have been taken for an open (?) intermaxillary suture.

Dr. Davis divides the ethmoid cells into two groups, anterior and posterior. I have preferred to divide them into three groups, anterior, middle, and posterior; the anterior ones being anterior to the passage way from the frontal sinus into the middle meati; the middle being those belonging to the bulla ethmoidalis, with outlets into the hiatus semilunaris; while the posterior are grouped further back, having outlets into the third meatus of the nasal cavity.

Slide 3 shows the outer wall of the nasal cavity of a fairly typical skull with portions of the conchæ turned up, it gives a good idea of the anterior, middle and posterior ethmoid cells, also the sphenoidal sinus.

Slides 4 and 5 give an idea of the great number of variation of the frontal sinuses.

Slide 6: Dr. Davis states that the sphenoidal sinus shows more variation than any of the other accessory sinuses. It is certainly very irregular in shape and size but I hardly think more so than the frontal. This slide gives a good idea of the position, extent, depth and divisions of a rather typical sphenoidal sinus.

Slide 7 shows two pictures a very irregular and large sphenoidal sinus, extending forward to the cribriform plate of the ethmoid bone and including it, also extending into the anterior clinoid process and around into the pterygoid plates. There is a difference of opinion as to one sinus opening into another. I will cite one case as an example. The maxillary sinus had been treated for empyemia and supposed to be cured, but one day I observed pus right there (indicating) and passed a sound backward and inward into the sphenoidal sinus. Dr. Davis stated that the maxillary sinus is the most constant of the nasal accessory sinuses and that the extent of its development is most regular. In my experience both with the living subject and in specimens, I find it is not constant or regular by any means. The slide just shown (No. 7) shows also small irregular maxillary sinus.

Slide 8 is a horizontal section, showing a wide nasal cavity, no maxillary sinus on the right side and a small one on the left side.

Slide 9 is a photograph of two specimens, the picture on the left shows two very large maxillary sinuses extending well over the roof of the mouth compressing the nasal

cavities very much, there would be very little difficulty in finding a place to open into these sinuses, the picture on the right is very different, showing a wide nasal cavity, extending outwardly to the outer wall of the maxilla, in this case in opening the maxillary sinus a careless operator might drill into the nose instead of the sinus.

Slide 10 shows a very large maxillary sinus with the sphenoidal sinus extending outward to the line of the molar teeth.

Slide 11 shows an entirely different character of maxillary sinus.

It also shows an enlargement of the cell in the orbital process of the palate bone, the outlet of this cell is into the third meati of the nasal cavity.

Slide 12 shows a peculiar and very small maxillary sinus. At first one is inclined to classify it as a double maxillary sinus with a complete septum, but such is not the case, the posterior cell is an enlargement of the cell of the orbital process of the palate bone with its outlet normal into the third meati of the nasal cavity.

Slide 13 gives a good idea of the relation of the maxillary sinus to the various surrounding structures such as the teeth, zygomatic bone, and nasal cavity, etc., in a child about the time of birth.

Dr. Davis speaks of the relations of the teeth to the sinuses. This varies with age and race. Slide 14, familiar to most of you, represents a transverse section of a typical Caucasian face, it shows the roots of the molar teeth well up in the walls of the sinus and the sinus extending below the apex of the roots of the molar teeth.

Slide 15 is a fairly good typical transverse section of the face of a negro, its teeth do not extend into the wall of the sinus because of the more cancellated tissue between them and the sinus.

Dr. Davis says: "Beside the recesses produced by the irregularities of the alveolar surface, pockets may be formed by osseous projections on the anterior or less frequently on the posterior wall. One of these "pockets' is formed so frequently that I venture to name it the infraorbital cell or sinus, the outlets are always into the maxillary sinus, the position of the infraorbital tube or canal has considerable to do with the formation of this cell.

Slide 16 from an x-ray picture of a section of a dried skull shows a well-marked infraorbital cell, on the inner side of the infraorbital canal.

Slide 17 shows another cell of this character on the outer side of the infraorbital canal.

Slide 18 is still another one. It will be observed that in the left picture the grooves are shown in the outer wall of the maxillary sinus for the accommodation of the alveolar vessels and nerves associated with the maxillary teeth which include the molars, premolars, and the canines—not the incisors.

Slide 19 shows an interior and posterior view of a section cut in the region of the premolar and first molar teeth. It will be noticed that the maxillary sinuses are small and somewhat pear-shaped. The right frontal sinus is seen to be very large, extending downwards to a point below the level of the center of the orbit, in close communication with the maxillary sinus and the nasal lacrymal duct.

Slide 20 shows the largest maxillary sinus I have examined and measured, the two sinuses holding 70 c.c. It will be noticed that they came within 19 mm. of each other in the region where the section is made, but more anteriorly, they are only 13 mm. apart, it will also be noticed that the floor of the maxillary sinus is much below that of the nasal cavity. The central incisors must be in close relation to the floor of the sinuses as the two sinuses approximate within 13 mm. of each other while the width of the two central incisors is 18 mm.

Dr. Burke.—I would like to ask for some information from Dr. Cryer or Dr. Davis: In widening the upper arch where there is a very narrow restriction, do you lower the dome of the arch as a result of widening the distance between the upper molars on either side?

Dr. Davis.—I have not had a chance for observation on that, and am not in a position to answer. I think Dr. Cryer, having seen that work, could answer, and I defer to his opinion.

Dr. Cryer.—In regard to the last picture on the screen, I do not believe it is possible to "lower the dome of the arch by widening the distance between the upper molars" as has been asked. You would have to take your measurement in the upper portion of the nasal cavity, down to the cribriform bone—to the teeth or alveolar process; that would be the

measurement. You might lower it in certain conditions by cutting off the teeth and alveolar process.

You would not increase the depth of the nasal cavity. It would stay exactly where it is, and I do not think the spreading of the temporary structure would change either the width or the height of the nasal cavity. I used to fight Dr. Ottolengui on that point, and I would like him to answer it right here,—as to his opinion as to lowering the arch of the floor of the nose by widening the dental arch.

Dr. Ottolengui.—There is just as much chance to lower the roof of this house by taking the partition out of the dining room.

Dr. Carl Case.—I have been much interested in certain statements brought out by Dr. Davis' paper and in the discussion because there is a certain man in my home town—an oral surgeon who is quite widely known—who has made the claim that the widening of the dental arch has lowered the dome in several of his cases and he can substantiate his claim with definite proof in the form of plaster casts and measurements. I have discussed the possibilities of such a result on several occasions and have refused to believe in it.

Dr. Ottolengui.—That was a kind of flippant answer, and I should not have made it. Most men who make that claim forget all about Dr. Cryer's pictures, and depend on plaster casts for evidence. They cut a section in the back of the plaster cast and move the teeth out, and measure that, and show they have lowered this just so much, whereas they have changed this whole shape (indicating). They forget that is not the shape of the roof of the mouth at all. On top of that is the septum and then the two walls. You can not pull that down.

Dr. Dewey.—I thought this discussion was on Dr. Davis' paper, and see it has resolved itself into the question of opening the intermaxillary suture and lowering the roof of the mouth. We have conclusive proof that the floor of the nose can be lowered, or that it does lower. If you will remember the pictures which so beautifully illustrated the development of the nasal septum, it has a beginning at the horizontal plate of the ethmoid, forming as a cartilaginous structure, etc. You have developed on the sides, plates of intramembranous bone. You have the nasal septum coming down from above as a structure belonging to the chondrocranium. The nasal septum will develop and not be influenced by conditions which influence the development of the superior maxilla. Structures laid down first are influenced last in the process of evolution. Structures laid down last are influenced first. The palatal bones are of late origin. In some animals the vomer projects down between the superior maxillæ and carries teeth. It will not be affected by conditions which affect the superior maxillary. In certain conditions of development the superior maxillary fails to develop as it should.

As a result of failure of development in growth, we have a deflected septum. We have conclusive evidence in those cases examined by competent rhinologists who have made measurements who have claimed those nasal cavities have been one-half to three-quarters their proper size. As a result of orthodontic treatment, the floor of the nose has been lowered, and the nasal septum has straightened out.

If you can tell me by any known means, how you can straighten that septum without an operation, except to lower the floor of the nose I should like to know it. You may say orthodontic treatment did not lower the floor of the nose, but the floor of the nose became lower during the orthodontic treatment. The fact is, you increase the space between the roof of the mouth and the roof of the nasal cavity. As you widen the dental arch, the curve increases, and measuring dentally, from the teeth to the roof of the mouth, the distance may be greater. But the roof is lower, compared to the ethmoid bone, than it was before. I can bring evidence, not only from my practice, but from other men, that the nasal septum does straighten out. We can prove that the suture may be opened, but we do not gain anything by it. The floor of the nose will come down whether it is brought down or it grows down.

Dr. Ottolengui.—Mr. President, I do not agree with one thing Dr. Dewey has said, and he does not disprove what I say. The proposition which the majority of orthodontists put up to their local rhinologists is, they can do this thing by mechanical means, and consequently I was absolutely right in sticking for mechanical means. You can not do it mechanically. As a result of lack of nutrition, imperfect mastication of food, and changing the whole metabolism of the individual, and by giving him a correct masticating apparatus you may have a resumption of normal growth, and a deepening or lengthening

or widening of the sinuses of the head. It is the result of improved metabolism and not a result of mechanical treatment. I have never denied these improved conditions may occur. The evidence of the rhinologist is not final, because the rest of the child has been growing. If measurements could have been taken from the top of the nose to the top of the chin it will be found that has increased also. Where you find excessive growth in that bone you will find a general increase in the size and growth of the whole individual, and it does make a difference when we say it makes no difference whether it comes down or grows down, and we should say that if we succeed in establishing correct metabolism, etc., we may depend upon normal growth.

Dr. Dewey.—Dr. Ottolengui thinks he agrees with me, but he does not. While the face lengthens, this lengthening would never occur if the orthodontic treatment had not been given. The nasal septum straightens out through orthodontic treatment. The face is made normal. Normal cell metabolism is brought about. I still contend that the floor of the nose has been developed, or comes down by a process of development started by orthodontic treatment.

Dr. Kemple.—I have not known definitely of a single instance of the septum straightening during the process of orthodontic treatment, and I am delighted to have Dr. Dewey say he can submit evidences of several such cases. I almost feel we have another paper for the next meeting of this Society.

Dr. Dean.—I have a case of a little girl six years old. She had a deflected septum and was examined by a rhinologist. He made measurements before she was six years old, and thought he could help her. At seven years of age he said he had not done any good at all. I made impressions of the mouth, and the upper jaw was three-fourths inch narrower than the lower. We made radiographs and measurements of the nose, and the Doctor also made record of the septum. In seven months from the time the expansion arch was put on to widen the upper jaw, the septum had straightened. The roof of the mouth (or floor of the nose) in the x-ray plates, was much thinner. Whether the bone stretched or not, I am not in position to say. The septum has straightened out and the floor of the nose had lowered, according to his measurements.

Dr. Weinberger.—I would like to ask the essayist whether generally, in full term fetal skulls, he has observed the presence of maxillary sinuses? In one slide he showed the sinus present, in the remaining slides I failed to observe them. The essayist showed as typical normal fetal skulls, skulls with the mandible either in protrusion or retrusion. I would like to take, at this time, the opportunity of stating, before reading my paper, that the textbooks showing these conditions and labeled "normal" are in error. If it is the experience of Dr. Davis that the skulls at full term either have a protruding or retruding mandible then those cases must be considered as abnormal.

Dr. Davis.—The numerous lantern-slide illustrations shown by Dr. Cryer serve to further show that definite conclusions can not be based on a few anatomic observations. As a medical student I did prosecting for Professor Spitzka and Professor McClelland, and was impressed by the frequency with which dissections of the accessory sinus areas showed types of development not in accord with the usual textbook descriptions. A few years later, as the Corinna Borden Keen Research Fellow, I resumed work along this line, studying the development from early fetal life to maturity. Most of the illustrations used in this paper are from dissections made at that time. Most of Dr. Cryer's illustrations are from middle-aged and aged specimens, which accounts for some of the differences in our specimens, also our difference in observations regarding the protrusion of the roots of molar teeth into the maxillary sinus.

In reply to Dr. Cryer's question as to whether one of his specimens should be classed as having a large single frontal sinus or as two sinuses in which the intervening wall had been resorbed or destroyed, I would classify the sinus as a single one, because it has only one ostium. Should the wall between two sinuses be destroyed the communication with the anterior ethmoidal area on each side would still persist.

Supernumerary frontal sinuses occur in probably three or four per cent of cases,—certainly a large enough percentage to show that anyone doing operative work in this area should not operate until an x-ray examination has been made. For, without such examination in a supernumerary frontal sinus case, should an opening be made into the medial sinus, there would be no definite way of telling whether going further laterally would open into another frontal sinus or into the cranial cavity.

Regarding the classification of ethmoidal cells, Dr. Cryer and I describe the same anatomic condition but use a somewhat different classification. He prefers the classification as anterior, middle, and posterior, while I prefer the classification as anterior and posterior, including the middle cells as a subdivision of the anterior group.

Cells which develop in such a way as to occupy the space usually taken by the posterosuperior angle of the maxillary sinus are simply aberrant posterior ethmoidal cells. One of my illustrations and one of Dr. Cryer's show such development.

Dr. Cryer's illustrations, showing an infraorbital cell, look as if the cell developed as an irregularity in resorption during development of the maxillary sinus.

Cells which develop in the orbital process of the palate bone are usually extensions from a posterior ethmoidal cell, rarely from the anterosuperior portion of the sphenoidal sinus.

My specimens probably show about the same variations in the level of the floor of the maxillary sinus as do Dr. Cryer's. The figures which I gave are what I found the averages to be.

Pneumatization processes extending into the middle turbinates, as shown by one of Dr. Cryer's specimens, are not cysts, but are ethmoidal cells which may develop either from the anterior or the posterior group. Cells occasionally develop from the anterior ethmoidal area in such a way as to produce pneumatization of the crista galli.

I have not followed out minute dissections to show the nerve supply of the walls of the maxillary sinus and the formation of the plexus supplying the teeth, thus can not answer Dr. Cryer's question from my personal observations.

Dr. Cryer asked where the "Davis family" make openings into the maxillary sinus when treating suppurative processes. That depends on the type of involvement. In acute or subacute cases requiring irrigation, we usually puncture the wall in the inferior meatus —a small puncture which does not leave a permanent opening. In the chronic type with thickened or polypoid mucosa, we make the opening from the mouth cavity—above the premolars.

The question of the possibility of lowering the dome of the roof of the mouth, I am not in position to discuss, since I have not had opportunities to make clinical observations. However, it does seem to be a point which needs careful observation by a number of the men of the Society,—making measurements not only of the arch itself but also on other portions of the face, so that the general growth of the face may be used as a control. A summary of such observations would be of value.

In reply to the question regarding the size of the maxillary sinus at birth, I would state that like all accessory sinuses at any period of development, they show considerable variation. The majority show a distinct maxillary sinus at birth, but the extent of osseous development of the medial wall varies a good deal. The specimen shown is practically an average development of the sinus at birth.

The protrusion of the mandible in the illustration of an infant skull is, I think, more apparent than is real in a fresh specimen, because the removal of the soft tissues allows the mandible to be shoved further up than when the soft tissues covering the alveolar processes are intact.

I wish to thank you for your close attention and for your discussion. I happen to see on the table here an invitation from the Mayor of Philadelphia, asking the Society to meet there next year. If the invitation is accepted I shall be very glad to arrange a larger exhibit of specimens than I have here—these being only a few to show the type of dissections upon which my observations were based.

THE HISTORY OF ORTHODONTIA

(*Continued from page 474.*)

By Bernard Wolf Weinberger, D.D.S., New York City.

GEO T. BARKER, in the *Dental Cosmos,* Nov., 1862, page 178, on *The Treatment of Irregularities,* states:

"The first subject of consideration in the treatment of irregularity is to ascertain when and for whom to operate. The time to commence either surgical or mechanical treatment can be answered in a few words, i. e., that no effort for correction should be attempted previous to the eruption of the permanent teeth. This, as a general rule, should be adhered to, although there are exceptions; but they rarely occur. I would not, however, wish to be understood as including in this remark those irregularities which are the result of the nonabsorption of the fangs of the deciduous teeth, and which are easily overcome by the removal of the temporary ones. The question, for whom shall we operate? can not so readily be answered; but this is, of all subjects, the most important, and deserves the most extended observation.

"In the treatment of irregularity, I have adopted the following general rule: When a case presents, and the indications are that the proper time has arrived to make use of mechanical appliances, my practice is to first impress the parents or guardians with the importance and necessity of the operation; stating to them that they will be held responsible, to a great extent, for any neglect on the part of the child to wear whatever plate or agent that may be used; and it is well, in the outset, to state as near as may be what will be the trouble on the part of the operator, and what will be the probable charge; for parents can not appreciate the labor, time, and expense which the dentist must devote to accomplish a satisfactory result, unless told of it, and no method seems better calculated to awaken the earnest interest of parents than to state that to succeed you will probably have to devote so much time and outlay, and that you consider fifty or a hundred dollars but a moderate compensation for the value of a successful result. The above sum is mentioned not as a criterion of charges for others, nor, indeed, of my own; for I hold that a conscientious man will recognize in the satisfaction derived from a worthy action a payment which will go far toward compensating him for time and trouble. In these, as in most dental operations, no definite scale of charges can be adopted or adhered to. The child should next be addressed, and every effort should be made to impress upon the mind the importance of the operation, and the great necessity which exists for the establishment of perfect confidence between patient and operator. Disguise no facts as to pain and inconvenience, if a painful and long-continued operation is expected, tell him of it, and my experience is that the child will acquiesce, and will give you his confidence, will do as you desire, and, like the little patient for whom it is necessary to extract a deciduous tooth, and who comes to the office dragged by the parent, but assured that the removal of the tooth will positively give no

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pain, if the operator, acquiescing in such deception, draws the tooth, confidence between the two can never be restored. If, on the other hand, he states to the little sufferer that the tooth must be removed, that it will give pain, but that he will be as gentle as possible, then it is that the child will read honesty in his countenance, his confidence is given, and he will submit to a painful operation oft-times without a murmur. So it is with the patient who presents for the treatment of irregularity; honesty, if strictly observed, will insure a successful result, even in cases where repeated trials and subsequent failures have been made. I have repeatedly known young ladies, of delicate nervous organization, to wear plates that were positively painful, and, what was more, remove, expand, and replace them, themselves.

"Of the different appliances necessary to overcome irregularity, but little can be said in a communication like this; but one rule can be laid down, and that is, make use of the most simple plate that can be made to do the work required, and those are always the best that patients can remove, clean, and replace themselves.

"The cooperation of the will is no small value in the treatment of irregularity as physiologists agree that the two primary actions, viz., 'composition' and 'decomposition' of the force of nutrition are modified by the influence of the mind; therefore, when the patient throws the mind upon the operation and assists in the introduction of the appliance, a satisfactory result is more likely to be accomplished and in a much shorter space of time.

"Having, as suggested above, stated the inconveniences and the importance of the operation, and having gained the perfect confidence and mental assistance of the young lady, my efforts were then directed to the correction of the irregularity, my object being first to expand the arch and to create a natural articulation of the bicuspids and molars, leaving the anterior teeth to be treated at a subsequent period. To accomplish this result I used a simple silver plate struck up to fit the roof of the mouth, removing it at first every three days to expand, cleanse, and replace it. This simple appliance was first, I think, introduced to the notice of the profession by Dr. T. L. Buckingham, and it certainly is invaluable for the purpose of expanding the arch. It was. for the first few weeks, retained in the mouth by two silken ligatures, one around each of the bicuspids, but in a short time the patient would each day remove it herself, expand the plate and introduce it, requiring nothing to keep it in place, also wearing it constantly. In two months' time I had gained, by actual measurement, three-eighths of an inch in the width of the arch, measured from between the first bicuspids.

"Not being able to keep a silk ligature about these teeth to induce their more rapid presentation, silver thread, as used on guitar strings, was employed with complete success. In effecting so rapid a change in the general contour of the arch, it will be presumed that more or less inflammation of the peridental membranes and adjacent soft tissues has been induced; but such is not the case, either in this or in other instances where rapid changes of the arch have been accomplished. It is true that more or less inflammation will be induced, but it can usually be overcome by using as a lotion a solution of the chlorate of potassa,

in the proportion of one to two drachms of the salt to four ounces of the water. The following recipe has been employed with value:

℞	Potassae Chloras,	℥ij;
	Tinct. Catechu,	f℥iij;
	Eau de Cologne,	f℥j;
	Aqua,	f℥vi.
	Fiat Solutio.	

The mouth to be rinsed with a small portion of the solution several times during the day.

George T. Moffatt, in the same journal, January, 1863, page 297, in *Treatment of Irregularities,* says:

"I made a plate of the vulcanite material (the 26th of May), covering the palate and capping the upper bicuspid and molar teeth, and antagonizing with the under molars and bicuspids. To this plate, by means of screws, I attached a gold band, which passed anterior to the incisor teeth, and having two hooks which caught under the cutting edge of the central incisors; these hooks effectually prevented the band from slipping up (Fig. 1). My next operation was to insert be-

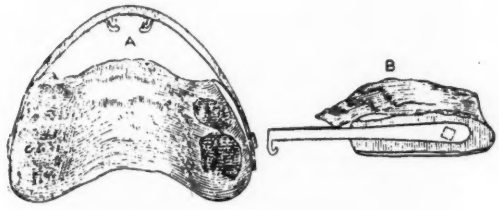


Fig. 1.

tween this band and the labial surfaces of the incisor teeth pieces of elastic caoutchouc, the operation of which was to press the teeth back. As the space between the band and the teeth increased, I either increased the thickness of the caoutchouc or shortened the band. I held the teeth in position until the thirteenth of September, when the appliance was removed."

H. Meredith White reported another case of *Irregularity* in the *Dental Cosmos,* 1863, page 472. "A plate was made for the upper jaw, with plain half bands for both bicuspids of each side; between the bands around the first and second bicuspids, and close to the situation between the necks of the teeth, there was placed on each side of the lingual surface of the plate a small ring, made out of a piece cut off the end of a spiral spring. To these rings were attached two spiral springs, one for each side; these converged and met in front immediately behind the space between the two central incisors, and were fastened to the shank of an anchor-shaped piece of gold. The shank was made flat, so as to fit easily between the centrals; the under surface filed out a little, so as to prevent undue pressure upon the gum; the pieces corresponding to the flukes of an anchor were flattened and hardened with a hammer, and were intended to rest against the labial surfaces of the central incisors. The springs attached to it were shortened from time to time, so as to keep up a continual pressure, drawing the teeth backward."

J. Foster Flagg in the *Transaction of the Odontographic Society of Pennsylvania, Dental Cosmos,* August, 1863, page 17, referring to those cases "caused by the protrusion of the inferior maxilla and consequently malocclusion of the teeth," says:

"For the correction of this form of irregularity, the ordinary practice has long been the adoption of a plate over the teeth of the lower jaw, upon which inclined planes were so arranged as, by occlusion with the upper teeth, these should be forced outwardly, and, at the same time, some backward movement of the lower teeth be effected by producing a certain amount of change in the angle of the inferior maxilla. The application of this force is dependent upon one of two causes; viz., the persistent efforts of the patients themselves in closing the teeth

Fig. 1.—J. Foster Flagg.

upon the planes, or by means of pressure with elastic bands arranged over the head and under the chin, after the manner of the Fox bandage, for preventing luxation during extraction. By means of these appliances, the corrections of very bad cases of this irregularity are sometimes effected in astonishingly short periods of time; but, on the contrary, it is not infrequently the case that month after month passes by without any manifestation of progress.

"Children will so protrude the lower jaw as to bite behind incredibly long planes, and, upon the least accession of tenderness, they will only eat such soft food as can be manipulated with the tongue, and never touch the planes at all. They will also complain of the hurting of the strap, and parents would rather discontinue its use than have their own or the childrens' rest disturbed, and thus the dentist accomplishes—a failure!

"Now this conclusion may seem unjust, and yet there is much truth in it, for I think that in the correction of irregularities all apparatus should be self-acting—so constructed as to require no cooperation on the part of patients, and, moreover, so arranged as to prevent the possibility of their interference with its workings. In consequence of these views, I have, for several years, abandoned entirely the use of inclined planes, and have substituted for them, in correcting cases of the kind under consideration, a combination of wire, ligatures, and gutta-percha, which arrangement I can much more clearly elucidate by means of models than by description.

"The first model represents inclined planes which had been adjusted upon the teeth of this patient, and worn for a period of one year. From want of cooperation upon the young lady's part, and from disinclination to bite upon tender teeth, no result was obtained.

"Model 2. Front view showing gold wire adjusted to upper teeth, silk ligatures thrown around lower teeth, and gutta-percha guard, to prevent occlusion,

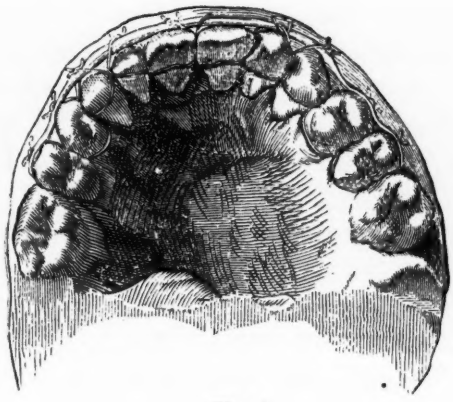


Fig. 3.

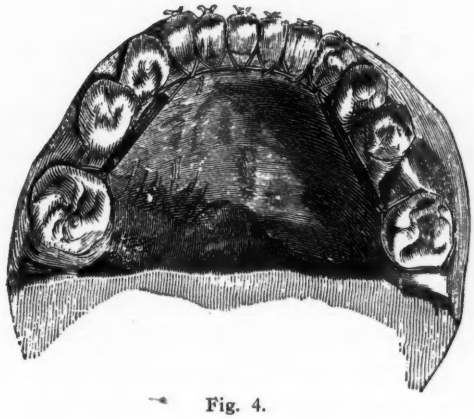


Fig. 4.

moulded upon left lower molars and bicuspid. The wire was secured by ligatures to the four superior bicuspids, and one central was gently brought forward by silk. After it touched the wire, it was firmly attached and thus having gained strong points at either end and in the center of the wire, the remaining teeth were brought into position with much ease and rapidity.

"Models 3 and 4. Inside views of both jaws, showing attachments to wire upon upper teeth, and the apparatus which was used for drawing the lower teeth in. Silk ligatures were thrown around the twelfth year molars, (both sixth year lower teeth had been extracted by the gentlemen who had employed the inclined planes with the view of insuring the correction.) India rubber rings (from tubing) were secured to these teeth, and attached together by a short double silk ligature; silk was then passed around the lower front teeth, and the two rings stretched, as is very clearly demonstrated in Model 4. (Figs. 3 and 4.)

"It seems to me that every argument which could be adduced would favor the treatment which I here suggest, and that no arguments tending to oppose it can be presented which would have weight either with unbiased practitioners, or, what is of quite as much importance, the patients themselves. I, therefore, shall briefly

consider (and illustrate by models) the possibility of great advance toward, and sometimes entire completion of, the correction of the irregularity under discussion, simply by due attention to the deciduous teeth and the application of an occasional ligature.

"The fact of the more frequent presentation of the lower permanent teeth posteriorly to the deciduous is probably known to all of you, and it is my practice, both by teachings and ligatures, to prevent any attempts on the part of parents which shall result in removing or even loosening the deciduous teeth, so long as it is possible to retain them with any comfort to the patient. By this means the inward inclination given to the inferior permanent centrals is so great as to frequently insure their position under the superior centrals, and if it is indicated, by the presentation of the superior centrals in the rear of the superior deciduous centrals, that this will not be accomplished, I at once remove the superior deciduous centrals and direct pressure to be made with the thumb on the palatine faces of the permanent centrals. The position assumed by the thumb is such as will at the same time naturally press upon the labial faces of the lower teeth, and thus a good result is almost always effected.

"I regard the accomplishment of a natural occlusion between the centrals as more than half the battle gained, for it will readily be seen by examining the dental preparations of subjects under six years of age, that the position of the forming teeth is such as will indicate their being governed, to a very great extent, both as regards eruption and location, by the proper or improper placing of the anterior teeth, for the laterals are formed posterior to the centrals in the inferior jaw, and the anterior to the centrals in the superior jaw."

Dr. Fitch described a case in which he expanded and protruded the front teeth by means of bars and screws, an apparatus consuming considerable time in its construction, and believed that the same result might be obtained by means much less intricate and troublesome. He dwelt upon the importance of permanently ligating teeth after the correction of irregularities, sufficiently long to insure a deposition and organization of new tissue for their retention. He thought that many dentists did not recognize the direction in which the permanent teeth should present in relation to the temporary ones. This knowledge he regarded as indispensable to success in preventing and correcting dental deformities.

J. H. McQuillen before the same society, in discussing Dr. Flagg's paper, says:

"As no remarks have been made with regard to the cause or causes of irregularities, he would take occasion to direct attention to four prominent causes. 1. Hereditary predisposition. 2. Bad habits. 3. Accidents. 4. Premature extraction.

"1. *Hereditary Predisposition.*—The opportunities frequently afforded of observing the contracted jaws, or the disproportion between the superior and inferior maxilla running through families, passing from parents to children, were not only interesting as subjects of study, but also suggested that, where such predispositions were known to exist, the proper remedial treatment might be commenced at a sufficiently early period to obviate the difficulty; and it was pos-

sible that, by continuing this care, in the course of one or two generations the predisposition might be broken up.

"2. *Bad Habits.*—A common practice among infants after weaning, and frequently continued for years afterward, of sucking their thumbs, was a prolific cause of that form of irregularity in which the superior incisors bulge forward and rest upon the lower lip. The disposition on the part of parents to permit their children to indulge a preference for soft food, almost to the entire exclusion of everything that requires a decided effort in mastication, (as instanced in the rejection of crusts of bread, etc.), was also highly reprehensible. The force demanded and the shock attendant upon the mastication of hard food was of decided advantage in enlarging and expanding the maxilla. The attention of parents should be directed to these facts.

"3. *Accidents.*—Under this head might be included the various casualties which children are liable to from falls, or being struck by balls, bats, etc., in which premature loss of the deciduous teeth is followed by a contracted arch.

"4. *Premature Extraction.*—Of this it was not necessary to say more than that the impropriety of such procedure is not only universally recognized by the profession, but the general intelligence of the people on this point is becoming more and more extended."

E. Ware Sylvester on *Abnormal Development of the Teeth, Dental Cosmos,* page 58, 1863, read before the *American Dental Convention,* says:

"When the architect designs to erect an edifice which shall not only be ornamental, but a lasting monument to his name, he is extremely careful to excavate deep and lay the foundation beyond all chances of disturbance, in order that the edifice in all coming time may remain unchanged and unchangeable. So the physiologist, if he would build a theory which shall stand the test of the most thorough scrutiny and investigation, must 'begin at the beginning,' and having so commenced, the causes of the disturbance in Nature's laws can be often plainly discerned.

"We come to the conclusion that the full dental arch and sound teeth are natural according to the designs of the Creator, and that a contracted arch and diseased teeth are the results of a series of violations of Nature's laws.

"1. Parental Influence.—'Like begets like.' 'As is the father so is the son.' These are truisms which have long since passed into proverbs, and are generally admitted. If both parents have well-developed mouths, and the child is reared in accordance with Nature's laws, it will have similar masticators. If one of the parents has a defective dental apparatus and the other perfect, some of the children will inherit the 'like' of the one, and some of the other, and often the two mouths will seem to be blended in the offspring. We suppose that all have seen cases like the following. The mother's mouth articulated in the usual manner, the upper incisors closing in front of the under; the father's antagonizing perpendicularly. Now it often occurs that the children of these parents will seem to have the right side of the mouth resembling the one parent and the left resembling the other. From the median line as a point, the two sides of the mouth are dissimilar, forming a difficult case to regulate and put in perfect shape.

"Defective teeth on the part of one or both parents seem to follow the same law that 'like produces like.'

"2. Gestatory Influence.

"3. Improper Diet.

"4. Impure Air.

"5. Want of Exercise."

Geo. Langsdorff published in 1863, *Praktische Anweisung für die Regulirung der Zähne,* a pamphlet I have been unable to obtain. Pfaff says, "he devoted himself mainly to the psychological conditions of the various 'methods' of irregularities and their causes." Among the methods he mentions false articulation, which is possible when one, several, or all of the upper incisors articulate behind the lowers, or when a tooth stands partly or entirely out of the proper range of teeth.

M. S. Cartwright read before the May meeting, 1864, of the *Odontological Society, Great Britain,* a paper entitled *Reflections on the Cause and Treatment of Some Forms of Irregularity:*

"Irregularity in the position of teeth in the human subject is the result of a departure from the normal type, in a greater or less degree, as regards the form and capacities of the jaws. The teeth are always normal as to size—that is to say—there is no evidence of teeth having at all degenerated in external forms and general proportions, when compared with old, and even teeth of considerable antiquity; but the old sculls which are brought to light, and oftentimes in some numbers, generally exhibit full capacity in the maxillæ. It may, therefore, be fairly assumed that irregularity—although expressed by—does not depend so much upon the teeth, as it does upon the absence of proportionate development in the maxillæ, and consequent want of space in the bones of the jaws which may be defined as the true cause of irregularity in the position of the teeth in the majority of instances.

"There are two forms of irregularity of the lower jaw, in which the circle of the teeth is larger than in the upper jaw, but in the one form the irregularity is dependent on the front teeth; in the other it arises from congenital abnormal size of the whole of the inferior maxilla, though both present what is termed underhung jaws.

"But in the first example—and what may be termed the false underhung—the front teeth from some cause or habit occurring during the eruptive stage, probably playing with the upper teeth, and so gradually, as the teeth extrude, getting a false bite, the lower jaw being brought abnormally forward, the habit arising mostly from the molars having been lost at an early period, whereby the pressure, on closure of the jaws, is brought directly on the front teeth, and an inclination is given to glide the lower over the upper teeth; but there is no irregularity in the form of the superior maxilla, and often but little inclination inwards of the teeth, although in some cases the front of the alveolar portion of the bone is flattened, and the teeth inverted. The molar teeth and bicuspids in these cases often antagonize normally.

"In the second example the whole range of teeth, as well as the jaw itself, is larger and wider than the superior maxilla; the inner cusps of the molars and

bicuspids of the lower jaw being received between the cusps of the antagonizing teeth of the upper jaw and the canines and front teeth biting freely forward, and in front of the upper incisors and canines.

"The former condition then is fortuitous, and is amenable to mechanical treatment; the latter is hereditary or congenital, and can not be remedied."

"Another form, not so frequently met with, is when the teeth in front of the mouth do not meet, but the back teeth come in too close and too early contact. Now this unsightly and unsatisfactory class of irregularity is dependent on the form of the jaws, the teeth are generally regular and as far as the arches go, they are well developed. The cases are sometimes congenital, but certainly not always, and seldom if ever hereditary: at least, I can not call to mind a case of the parent being so circumstanced; nor have I seen the deformity transmitted to the children by the parent whose mouth presents this form of malformation.

"The receding chin is a marked feature in these cases, and the opposing surfaces of the alveoli with the teeth present convexities.

"Next there are the various degrees of contracted jaws. Some really congenital, with the compressed sides and deep palate, and often presenting regular, but projecting anterior dentures; others hereditary, and some manifestly dependent on the pressure of crowded teeth.

And lastly, the angular jaw confined like the last to the upper maxillæ and teeth, in which the width is great between the molars, and which answers to the base of a triangle; but the incisors are angularly placed, and which answers to the apex of a triangle, and the distance between the apex and the base is comparatively less than we find to be the case in well-developed jaws. These forms assume the hereditary, the congenital and the mechanical types.

"I have enumerated four principal forms of jaws which favor irregularity in the position of teeth, and they comprise the hereditary, the congenital, and the mechanical types.

"Hereditary irregularity applies to transmitted peculiarities as regards the conformation of the jaws, and also to transmitted irregularity of particular teeth—absence of certain teeth, or the presence of supernumerary organs.

"Congenital malformations of the maxillæ are abnormal forms, *per se,* and occur usually without any hereditary predisposition, although in some forms they prove to be hereditary.

"Mechanical irregularity is not so much dependent on the form of the jaws as it is on the position of certain teeth, whereby obstruction to due placement is produced by interlocking or misapplied apposition.

"Practical deduction then inclines one to the conviction that temporary teeth have no part in preserving the form of the jaw, and that their removal does not in the least interfere with its due development and growth. They have their special mission, which they properly fulfill under favorable circumstances, during the developmental increase of the jaws of early childhood.

"The second denture growing within their crypts plays the important part of aiding the developmental features of the alveolar portions of the maxillæ, and has doubtless the principal share in determining the forms of the arches of the jaws; and, with the exception of the forward position of the anterior permanent

molars, when the temporary posterior molars have been early removed, no ill effects that I have seen, as far as the second denture is concerned, result from the removal of first teeth.

"The mechanical treatment of irregularity has very much increased of late, but I purposely confine my observations to that particular treatment which ignores the propriety of removing teeth, and insists on developing the alveolar arches by pressing crowded teeth into a regular circle. It is better practice, and more conducive to the welfare and comfort of the patient, I will say—taking the past, the present, and the future into consideration—to deal with small jaws and irregular teeth by mechanical means, or to prevent irregularity by the timely and shorter treatment of removing certain teeth, in order to make room for the harmonious placement of the rest."

Thomas Ballard, on the Constitutional Ill-Effects of Fruitless Sucking, and the Diagnostic Value of Deformed Jaws in Relation Thereto, read before the *Odontological Society, Great Britain,* page 147, *Transactions,* 1864, states the following:

"If an infant be exposed to fruitless sucking, which it may in various ways, the dangers which beset it are numerous and most serious. Tracing them briefly from birth, they are, primarily and principally, the green purging, with its attendant abdominal pain, which, with the sore mouth, constitutes thrush, a disease proverbially prevalent very soon after birth.

"Should the infant escape death in any of the above-named shapes in the first few weeks, and the state of diarrhea persist, then hydrocephalus is sure to supervene; and under this head I include all the various forms of convulsive and paralytic diseases to which children are liable, as I believe them all to be mere modifications of degree of the one common defect; viz., imperfect growth of the brain consequent upon defective nutrition, which necessarily results from partial destruction of the tissues of the stomach in the mode previously described. Thousands of children die annually of these diseases; but many sufferers escape death, and they constitute the various defective individuals with which all classes of society abound. The worst form is the idiot, and in this class there are many degrees; besides, there are the rickety, the phthisical, the ill-grown, and those who are simply weak and delicate.

"It is objected against my views that I attribute too much to the ill-effects of fruitless sucking; but I urge attention to the subject of the deformities of the teeth and jaws in support of my doctrine. I hold that the deformities to which I refer, some of which are exemplified by the models on the table, are produced solely by the retained habits of sucking; and it is the children who have been exposed to fruitless sucking and consequent persistent diarrhea, with its attendant evils, when infants, who acquire the retained habits of sucking, and thus get their jaws deformed. And as in idiots are seen the worst forms of defective growth, so also do they exhibit the most aggravated forms of deformed jaws and teeth, the habits of sucking being retained by them to an advanced age. This statement can easily be verified by anyone sufficiently interested in the subject to be induced to visit one of the asylums devoted to the reception of these unfortunate individuals. So also are the deformed jaws and teeth com-

monly to be observed among the ill-grown, the phthisical, and the weak and delicate members of society. The normal jaw with well-set and perfect incisor teeth, is the principal characteristic feature of an individual possessing a sound constitution.

"The various sources of fruitless sucking to which infants are commonly exposed are as follows:

"a. Being put to the breast before the milk is secreted, i. e., before sixty hours have elapsed after delivery.

"b. Being allowed to suck long at a breast which does not yield as much milk as the infant requires.

"c. Being fed from a bottle fitted with a calf's teat, a piece of wash-leather or parchment, or a long-used india rubber teat.

"d. Or being supplied with a sugar teat (the Zupel or Zulp of the Germans), which consists of some moistened bread and sugar tied up in a rag, and is given to the child to suck in order to keep it quiet. Some monthly nurses have the custom of constantly using this, and when they take the child up from its bed, the sugar teat is taken from its mouth and slipped into the nurse's pocket.

"It will also be certain to acquire a 'retained habit of sucking' either some portion of its hand or tongue, and then will eventually acquire a deformity of the jaw, which will bear some sort of proportion to the extent of injury which the child has sustained by the habit.

"Before I conclude I am desirous to direct your attention to another defect of the teeth resulting from fruitless sucking. The irritation of the gums which is set up by the constant friction interferes prejudicially with the growth of the incisor teeth.

"So in reference to the permanent incisor teeth, I believe the serrated and honeycombed varieties are the result of some form of fruitless sucking during the first three years of life. To illustrate this, I have two brothers: one was fed by a bottle, and acquired a retained habit of sucking the blanket, and he has serrated incisors; the other was spoon-fed, did not acquire a retained habit of sucking, and his incisors are perfect.

"The points then I am desirous to see recognized are, that the serrated and honeycombed incisor teeth, as well as the peculiar projections of the jaws, which result from the various forms of tongue- and hand-sucking, are evidences that the individual has been exposed when a child to the prejudicial influences of fruitless sucking, and that the various degrees of weakness and delicacy usually exhibited by such persons are not the result of any hereditary disease transmitted by the parents, but an acquired state, the consequence of having been exposed to the evils in question."

G. M. Humphrey in the *British Journal of Dental Science,* 1864, page 447, speaking on *The Growth of the Jaws,* says:

"Analogy leads us to suppose that the enlargement of the jaw bones is effected, and their proper shape is given and preserved, mainly or entirely, by addition at some parts and subtraction at others, there being little or no interstitial growth; and the disposition of the teeth and changes which take place during second dentition, as well as the position of the additional teeth of the second

series, and a comparison of the arch of the lower jaw at different periods of life, are confirmatory of that view.

"In the lower jaw the five anterior teeth, on either side, are formed below and behind the five deciduous teeth—the two permanent incisors beneath the two deciduous incisors, the permanent canines beneath the deciduous canines, and the bicuspids beneath the deciduous molars. As they ascend they advance a little forwards into the places of the deciduous teeth. The permanent incisors and canines, being larger than their predecessors, occupy rather more space, and extend a little beyond the range of the deciduous canines, so that the permanent canines encroach somewhat upon the territory of the deciduous molars. This is, however, compensated for, and room is afforded, by the size of the bicuspids not quite equalling that of the deciduous molars. The third molars of the child, which are also the anterior molars of the permanent series, and which are formed immediately behind the hinder deciduous molars, retain their position throughout life, and the alveolar arch between them, in which the ten deciduous teeth and their ten successors are placed, undergoes very little alteration of size or shape after birth. Even while the two halves of the jaw remain separate there is very little growth at the symphysis; and after they are anchylosed, which takes place between the sixth and ninth month after birth, the growth at this part seems to be entirely arrested.

"The fact is the part of the arch of the jaw which is first formed; viz., the part intermediate between the alveolar and the lower edges, retains its original curve, undergoing no alteration of form; but as the bone increases upwards and downwards the new part is, in each direction, and more especially below, thrown a little outwards, that is, into a wider curve. Slight additional space is thus afforded for the teeth, and a convex vertical outline is given to the hinder surface of the jaw. In the European jaw the projection of the alveolar part is very slight, that part and the teeth being nearly vertical, whereas the lower or mental edge is thrown out considerably, giving a marked prominence to the chin. In the Negro the mental projection is less, and the alveolar projection is greater; and in the monkey and other inferior animals the alveoli become thrown out into an arch extending far beyond the range of the jaw at birth, but the chin remains suppressed to its original curve or nearly so.

In the upper jaw, the relations of the several primary teeth and their successors to one another is the same as in the lower jaw; but the enlargement of the alveolar arch by extension outwards, during its outward growth, is somewhat more marked. Hence the alveoli and the teeth acquire a more oblique direction; and hence the incisors and canines project in front of their opponents in the lower jaw, so as to admit the cutting edges of the lower incisors to be drawn up, scissor-like, behind the edges of the upper incisors, when the jaws are approximated.

"The additional teeth of the second dentition (the two hinder molars on each side) are placed behind those of the first dentition, in a line which is a continuation of the alveolar line of the infant. This is shown by placing an infantile jaw upon an adult jaw, so that the alveoli of the two correspond; for

the permanent molars of the adult are, then, seen to be in the same line with the temporary molars of the infant.

"The only mode in which we can conceive the lower jaw to be thus elongated is by a gradual absorption of the fore part of the coronoid and condyloid processes, and a gradual addition to the hinder part of those processes, as well as at the angle and along the hinder edge of the jaw. In this way the coronoid process, which is at first situated over the rudiments of the permanent molars, may become shifted to a plane behind them.

"I have already remarked that the additional molars of the permanent series grow up, on either side, in a continuation of a line formed by the primary teeth. Hence, though the bones of the alveolar arch are extended backwards, and the arch is rendered more elliptical, it is not widened. The widening of the jaw, in correspondence with the increasing width of the base of the skull, takes place almost entirely behind the alveolar arch, in the ramus, and must be effected by a progressive absorption on the inner surface, and an addition at the outer surface, similar to the absorption and addition that are taking place, respectively, at the coronoid and condyloid edges. Accordingly we find that, in infancy, the rami of the jaw are in a line with the alveoli; whereas, subsequently, they diverge considerably, and a well-marked obtuse angle, in a horizontal plane is formed, on either side, between the alveolar arch and the hinder portion of the jaw.

"The gradual diminution of the angle between the horizontal portion of the jaw and of the ramus, from an almost straight line to a right angle which is, partly, for the purpose of affording vertical space for the molar teeth, is effected by absorption at the base of the coronoid process in front, and addition at the 'angle' behind. These changes are most marked in the European members of the human family; and it is, probably, a consequence of these changes, and of the smallness of the angle in which the hinder molar or wisdom tooth is developed, that it is liable, in its growth, to intrude upon the mucous membrane in front of the coronoid process, causing irritation of it, and, so, imposing some penalty for the peculiarity of our configuration.

"In the upper jaw the changes are very similar to those in the lower. The permanent molars, developed behind and above one another in the 'tubercle,' descend and move backwards; and the space for them is formed by addition to the hinder part of the tubercle. During this period the contiguous pterygoid processes of the sphenoid bone undergo alterations similar to those in the coronoid processes of the lower jaw, that is, they receive addition behind, and are absorbed in front, and are so rendered more vertical. The malar eminence of the maxillary bone, and with it the zygoma, are, in like manner, thrown backwards; and, as the bone is deepened by addition to the alveoli, from beneath, and as the teeth grow down into the alveoli, and become distanced from the orbit, the interval between them and the orbit is occupied by the antrum."

On page 489 of the same journal under *Plasticity in Orthodontia,* we find, in an unsigned article, the following:

"The dental surgeon who has had many cases of irregularity in the upper incisors to correct, must at times have found it difficult to retain the regulating

plate sufficiently firm in the mouth against pressure inwards, if the teeth had to be pressed outwards, or against the pressing outwards if the teeth had to be drawn inwards. The ordinary methods of making the regulating plate secure in the mouth is by gold bands, silk ligatures, or capping the teeth tightly with gold.

"I fitted a vulcanite plate to the palate, extending to the molar and bicuspid teeth, and over the gums to the loose folds of the mucous membrane. I then cut it until it antagonized with the lower teeth. The cells were then cut behind the lateral teeth for the reception of the compressed wood. The plate was cut out a little inside, sufficient to admit a lining of gutta-percha, and was then thinned and polished. A few holes drilled on the buccal sides of the plate, together with the affinity the gutta-percha has for the vulcanite, is sufficient to make the two adhere together. After adjusting the gutta-percha to the mouth, which may be done by leaving it a few minutes in boiling water, drying it carefully, heating the vulcanite plate over the plate of a spirit lamp, and joining the two together, trim, and place into the mouth, desiring the patient to bring the teeth together hard. The surplus gutta-percha may then be trimmed off. After again heating the plate in boiling water, the same process is repeated, until the vulcanite plate is home. With the aid of cold water the gutta-percha must be made hard previous to withdrawing the plate from the mouth; and when the pieces of compressed wood are fitted to the cells previously made for their reception, the plate is ready for final adjustment, with three such plates, which are quickly and easily made. I pressed the two lateral teeth, first to the side (being behind the centrals), and then out, a quarter of an inch, in fourteen days.

"The advantages of the plastic method in retaining the plate are, that the teeth and gums are not irritated, as not unfrequently occurs when tying is resorted to; and the pieces of wood are more easily renewed, admitting of the daily cleaning of the plate by the patient, which is of so much importance to the preservation of the teeth. I order the plate and teeth to be daily cleaned with chalk and carbonate of soda, and afterwards washed in a weak solution of Condy's disinfecting fluid."

Alfred Coleman before the *Odontological Society of Great Britain,* February, 1865, read the following paper: *On Some Forms of Irregularity of the Teeth and Their Treatment, Considered Chiefly in Relation to Mr. Cartwright's Theory of the Influence of Selective Breeding Upon the Development of the Maxillæ,* which is published in the *Transactions of The Odontological Society, Great Britain,* page 227:

"There are two principal varieties of contracted jaw met with: in one the teeth bear their due relationship to the maxillæ, as regards actual development; but where the latter have their palatal processes raised into a higher and more pointed arch, and where the alveolar processes of each side become consequently approximated,—it is difficult to explain the cause of this deformity: in some cases the habit of finger-sucking, as suggested by Dr. Ballard, may have caused or increased it; in others, where no such habit has existed, it appears to be connected by links with those arrests of development which cause cleft palate. This variety, though congenital, may yet become hereditary, and

our notions concerning the form of countenance indicative of good breeding certainly tend to cause it to become so. The other variety is that in which the teeth are in excess of development as regards the maxillæ, or, to speak more correctly, where the maxillæ do not attain their average development, whilst the teeth attain their normal size.

"One thing is certain, that whether they arise from the causes suggested or not, they are daily becoming more common amongst us, and therefore the question of their proper treatment is one involving no small consideration. As the maxillæ in these cases do not attain their average development whilst the teeth attain their normal size, so that in fact there is too much tooth substance in proportion to the size of the jaws, two principles of treatment naturally suggest themselves: the one the increasing of the size of the jaws, if possible; the other the lessening the amount of tooth substance. Much has been written and much has been said upon the expansion of the alveolar arch, as if its accomplishment were a matter of but little difficulty. In my own efforts, chiefly, however, directed to the other form of contracted alveolar arches noticed, I have found that they have been unavailing. By fixed points for applying pressure, the teeth, have readily yielded and have been pushed to the outer margin of the alveolar process. The dental arch has been expanded, but not the alveolar arch; and this is only reasonable when we remember that resistance to our efforts is not only offered by this bone itself, but probably to some extent also by every other bone composing the face and cranium. Nor must we forget also the influence of muscular resistance, not only tending to counteract our efforts, but also to restore the former conditions upon the withdrawal of the expansive force. I have read of the two superior maxillæ being actually forced asunder at their palatal and labial articulations, in attempts to expand the arch, a state of things I should hardly think advantageous, and certainly not one I should feel very proud of having accomplished. For all practical purposes, I think, we may at once dismiss this method of treatment, though its usual result, the widening of the dental arch, demands more consideration.

"The nearest approach to a rule in the treatment of irregularities might be thus stated: 'that when the maxillæ are in regard to the teeth deficient in development, some of the latter should be removed, whereby the harmonious relationship of teeth to maxillæ may be restored;' and this practice would I advocate, not merely on the ground that the personal appearance is improved thereby, but also with the view of preserving the teeth themselves, the table before you showing their inferiority in the contracted and crowded dental arches."

John R. Mummery read a paper on *Abnormal Projection of the Incisors and Cuspidati,* which was published in the *Transactions of the Odontological Society, Great Britain,* 1866, page 73:

"In the first place I shall refer to the age at which, in my judgment, these cases should be undertaken. I believe that a very large proportion of failures are attributable to the mouth being treated for irregularity before the second permanent molars are erupted. If the first molar is removed before the roots of the second molar are well developed, we usually find that the grinding surface of the latter tooth, when it appears, is found inclined very considerably forward, furnishing a very indifferent masticating organ.

"As a general rule I defer commencing treatment until the patient is entering the fifteenth year, that opportunity may be afforded for the natural expansion of the maxillary arch, thus possibly obviating the necessity for sacrificing any of the permanent teeth.

"Although the first molars are proportionally more liable to decay than the bicuspids, I much prefer removing one of the latter teeth on each side, carefully selecting the first or second bicuspids, as there may be indications of incipient decay.

"I give early attention to the state of the molars with a view to their preservation, and fill with gold any cavity that may exist, at the earliest stage of disease.

"I thus secure a firm fulcrum for my plate, by capping one or both pairs of molars, or two molars and two bicuspids.

"My usual apparatus is of a construction very familiar to the members of this society—a broad well-strengthened gold plate, having strong springs of sixteen-carat gold-plate, No. 16, and well-hammered, soldered upon the lingual side-cappings of the molar teeth, and, as occasion requires, on the outer side also.

"In the great majority of cases, I, of course, recognize the importance of removing a corresponding number of teeth from the lower jaw, and when the lower front teeth strike against the necks of their antagonists, I always take the lower teeth under treatment before the upper; adopting, with slight modifications, a similar apparatus to that already described.

"The springs are brought to bear on one pair of teeth at a time, commencing with the bicuspids, and always bearing in mind as my chief object the expansion of the arch in the neighborhood of the cuspidati and bicuspids.

"The elastic springs admit of the most delicate adjustment, and the pressure should be so gradually increased, that little or no pain is induced; and each pair of teeth in succession may thus be treated, until at last the central incisors are brought into their proper position.

"The plate requires to be re-struck to a new model occasionally, and when all the teeth are reduced to a regular position, it is finally remodeled, and a slighter elastic spring on each side is soldered to the cappings, and accurately adjusted to the labial surfaces of the corrected teeth; they are thus retained in position, and the plate should be laid aside very gradually, continuing its use at night for a period of many months after the treatment is brought to a close.

"There are several advantages attending the use of gold plates thus constructed which, in my opinion, render this a preferable method of treatment to certain others which are sometimes adopted.

"The plate is easily removed by the patient, yet keeps firmly in its place.

"It can thus be cleansed three or four times a day, and the teeth well brushed, and a great amount of the alleged injury to the teeth is avoided.

"Although gold is harder than bone or vulcanite, yet it is not nearly so hard as the enamel, and I firmly believe that the decay on the crowns of teeth when in contact with gold plates (employed either for artificial teeth, or for regulat-

ing the dentition) is rather attributable to chemical than to mechanical action."

C. A. Marvin has a remarkable series of eight articles in the *Dental Times* commencing in Vol. 4, 1866. These I will quote in great detail as I believe it will be of sufficient interest to my readers. Under *Regulating Teeth* he states:

"This is a subject upon which much has been written and said, and upon which much more may be written and said, without any fear of exhausting it. As long as the proper care of children's teeth is so little understood, or so grossly neglected by parents; as long as the numerous known and the still more numerous unknown causes of irregular teeth exist in the world; so long will this branch of dental art possess an ever-new and ever-vital interest to the enlightened members of our profession.

"In regulating teeth, several objects are to be attained, and they are always to be kept in mind throughout the continuance of the operation. They are:

"1st. The preservation of correct facial expression.

"2nd. The restoration of such expression, (if, through the irregularity of teeth, it has been lost.)

"3d. The proper articulation of the teeth for better mastication.

"4th. Their orderly arrangement, with a view to the prevention of decay.

"Here is enough for four sermons, but within the limits of a single paper I can only generalize.

"One general principle may be asserted, however, which it were well if all dentists would observe, and that is this: do not resort to extraction for the purpose of giving room to such teeth as are out of position. This is an error into which many dentists have fallen, and from which have resulted cases of permanent disfigurement beyond the pale of recovery. I do not mean never to extract in regulating, for there is no rule, nor principle, nor condition to which there may not be exceptions; but I do mean that this method should be the very last resort.

"Nature makes all parts to correspond, and when she supplies a certain number of teeth in the mouth, it is fair to infer that the presence of all those teeth is necessary to regularity and perfection. If they are crowded, it indicates that there is unnatural contraction. What is the remedy? Expansion of the parts, of course. And when this is properly done, and sufficient room secured, with all the teeth retained, a symmetry of outline is observed, which is at once pleasing and natural, and which can be attained in no other way. In the most contracted mouth, by commencing with the first molars, and spreading them, then following with the second bicuspids, and so on, in order, to the central incisors, very rarely will any difficulty be found in obtaining sufficient space for such teeth as may stand outside or inside of the proper circle. In doing this, constant regard should be had to the facial expression, that the incisors be not moved so far outward as to give a swollen appearance to the lip. Where there is danger of this result, the bicuspids or molars should be made to furnish the largest share of the space required, as these teeth can be well spread without materially affecting the appearance of the cheeks. Two methods of accomplishing this end are in use, both of which are effectual. One is by fitting a plate to the roof of the mouth, (if the upper teeth are to be regulated) with broad collars

next the teeth which are to be spread. Between these collars and the teeth, wedges of dry pine wood or rubber are to be inserted as tightly as possible, and changed every day; thicker ones being substituted, until the teeth are moved as far as is desired. A second method, and an excellent one, is by making a bow of stiff gold wire, long enough to pass entirely around the teeth, from molars to molars. Fit gold caps accurately to the crowns of the last molars, on each side, and solder the ends of the gold bow to the buccal surfaces of these caps. When this appliance is firmly fixed in the mouth, elastic ligatures passed over the teeth which are to be moved, and attached to the bow, will draw them in any desired direction, and to the requisite extent.

"It is, of course, unnecessary to say that, after the teeth are brought into their proper place, a retaining plate must be made, which is to be worn until they are firmly set in their new position. The length of time required for this varies in different cases, from three to twelve months. It is of the utmost importance that this retaining plate should be what I have called it—a retaining plate. The teeth which have been brought from an improper to a proper position, should be held there immovably, that there may be nothing to prevent the perfect filling up of the alveolus, or tooth socket, closely around the roots of the teeth. If they are allowed to move backward and forward, Nature can not accomplish her work and they will not become firm. Attention to these little matters will oftentimes prevent much dissatisfaction to patients, and mortification to dentists.

"As to the age when art should be called in to aid Nature, opinions vary—I say to aid Nature, by which I mean that this should be done at some stage of the period of growth. While a tooth is growing, a very little force will change its direction, while much would be required after it is fully developed, and growth has ceased. But if begun too early, evil may ensue. Nature will many times, entirely unaided, correct irregularity. To employ artificial means, therefore, in such cases, would be not only unnecessary, but perhaps, hurtful, by producing unnatural irritation, or by inviting early decay through the friction of metallic appliances upon tender teeth, or by making convenient lodging places for particles of food to remain until partially decomposed. If, on the other hand, the treatment be delayed too long, either or all of the following evils may ensue: loss of some of the teeth in consequence of the too great rigidity of the parts for successful expansion; or difficulty of retaining the teeth in their new position, owing to the more tardy adaptation of the parts, and the slower formation of bony tissue in and around the roots; or the dangerous luxation of the teeth in consequence of prolonged traction, which tends to greater protrusion of the organ.

"The nearest to a rule which I can give, is this: to commence as soon after the necessity is apparent, as the dentist can determine this point; viz., that the eruption of teeth yet to come, or the subsequent growth of those already erupted, shall not undo his work; in other words, when he sees that the teeth he may succeed in regulating, are in no danger of being pressed out of position again by the new and growing teeth, and thus the repetition of the operation rendered necessary.

"The earlier the operation can be commenced, consistently with this caution, the better.

"Too great haste should also be avoided. Harsh measures in treating teeth, especially in the mouths of the young, are to be strongly deprecated. Teeth are delicate organs, and if a regard for the feelings of the young patients has no weight with the dentist (which it certainly should have), let this thought have weight; viz., an amount of irritation may be produced, which may result most disastrously. Slow, steady and unremitted motion is proper, but I have no sympathy with the sudden and harsh pulling and prying of teeth from one position to another. Gentleness, all the gentleness consistent with progress, should be practiced in every operation.

"Correct facial expression. What is it? It is not the mere absence of deformity. It is merely that condition of the features which enables the individual to use them at will in expressing joy, sorrow, disgust, pity, conceit, anxiety, or composure of mind. It is not merely that the nose is straight, and that the angle formed by its base and the right cheek is exactly equal to that formed by its base and the left cheek; that the corners of the mouth are level, and that the lips meet evenly. It is not that words can issue from the parted lips smoothly and unaccompanied by contortions or evidence of effort; that smiles of sweetness can play around the mouth, and an expression of unfeigned pleasure appear on the face, without a distressing exhibition of struggle between feature and feeling. It is more. Physiognomists tell us that the prominent traits of human character are marked upon the face. But, in my judgment, the subject which we are examining makes sad havoc with many of their theories. An absolutely correct expression of the face would undoubtedly be a physiognomical expression; but, taking expressions as we find them, physiognomy is sadly at fault. Let ten persons present themselves for examination according to physiognomy, strictly, and while undergoing examination, let them close their eyes and lips, and seven out of the ten characters would fail of being correctly delineated. Why? The soul—the seat of character—is shut in from view. Its windows—the eyes—are closed; the exponents of its varied sentiments and feelings—the lips—are fixed; consequently the inner being can not be seen, and judgment can only be formed from the features. Some general idea can be gained from these; but in the absence of the eye-glance and the mouth-motion, no reliable or minute opinion can be reached. It is only when the thought within is betrayed by the eye or manifested by the involuntary workings of the features, that the revelations of the science of physiognomy, so aided, can be relied upon.

"Now, it may be asked, what all this has to do with regulating teeth. And perhaps a smile of approval may cross the lips of the reader as he sees the question. Do not let us forget, my practical friend, that as members of a profession, which claims to be a learned profession, we not only have the right, but should esteem it a duty to investigate closely as to remote details. It is easy to arrest the seeker after knowledge when pursuing a line of thought to remote depths, with a blunt, practical question, and sometimes it is necessary; but it should not be thrown in until the irrelevancy of the examination is apparent, else it not only chills the eager investigator, but betrays an absence of perception on the part of the objector, not specially flattering.

"It is not intended that all dentists should immerse themselves in the study of physiognomy as a science, that these remarks are made, but to show that

the study of the expression of the face is an important subject; that it has been so deemed, and that it is so deemed in the present day; and it will not do for the practitioner of dentistry, who claims to be an intelligent and competent man, to ignore it, or say there is little in it. Physiognomy, as I have intimated, can not, in my judgment, substantiate all that it claims. Its far-fetched inferences and fine-spun theories are too multiform and minute; but there is something in it, even as a science. There is more good, however, in its effect than in itself. Its effect is close scrutiny of the human countenance; and if we are at all interested in it as a science, we find ourselves endeavoring to trace on the human face evidences of what we know to be prominent traits in the character.

"Now this is just where I wish to bring my readers, in this article; viz., to become students of the human face. Not for the purpose of establishing any theory, or propping up any 'ology' whatever, but that they all may be able to determine for themselves what correct facial expression is. This is of prime importance to the dentist. I can not find language too expressive to set forth my estimate of its value; nay, of its indispensable necessity.

"How can a dentist insert an artificial denture that shall be an evidence of professional skill, unless he is able to determine what expression of the mouth he is to secure? In the absence of this knowledge, what is he but an artisan, and his set of teeth the product of mechanical skill alone.

"Some general directions may be given for the formation of an opinion as to correct expression. But such directions can only be very general. The details can be gained by study alone.

"First, then, observe the outlines of the face; notice the prominence of the forehead and of the chin, and the fullness of the cheeks.

"Next, observe the relations between this feature—the mouth—and the other features; is it so related to them as to attract no special attention to itself, is the harmony of the features unbroken, and when a front view, a quarter view, or a side view is taken, do all appear well balanced? If so, let them remain thus; and, in all the operations upon the teeth, let great care be taken not to disturb the outward expression.

"Many a person has been so changed in the expression of face by dental operations, as to be hardly recognizable by their friends. Their identity has been lost. Such is not dental art. Improvement, or no change, should be the rule, and the dentist should fit himself to work by this rule.

"Sometimes, in order to correct the irregularity caused by a contracted arch, upper, for instance, it may be necessary to throw out all the teeth, enlarging the entire arch, and to do this to such an extent as to give the incisors an outward slant or inclination. Indeed, this has to be done at times to such a degree as to leave a deep impression in the upper lip just at the base of the nose. This irregularity will sometimes require the insertion of a mechanical appliance for its entire correction. If this enlargement of the arch is effected in the mouths of children when quite young, the depression in the gum just above the roots of the teeth may fill up by the growth of the parts. If so, well. When performed on patients over the age of fifteen, there is little hope of this consummation being effected by Nature. In such cases, a well-shaped and accurately fitted 'plumper' of vulcanized rubber extending around the entire upper

gum, from molar to molar, and secured by slight and ingenious attachments to the molar teeth, will bring out the lip to its required fullness, and be of no inconvenience to the wearer.

"I come now to consider the third general rule, of those heretofore enumerated, to be observed in operations for regulating natural teeth; viz.,

"The proper articulation of the teeth for better mastication.

"A moment's reflection will convince anyone of the vast importance of this arrangement. Of the distinct operations, mastication, deglutition, digestion and assimilation, by which food is converted into animal substance, and strength becomes the result, the most important is the first. Nature has assigned to each part of our physical machinery a distinct duty. To the mouth, mastication and insalivation; to the stomach, digestion; i. e., the dissolving of the swallowed mass, the separation of the nutritious from the useless; to the absorbents, the appropriation of the nourishing elements, and the dispatching of a portion to each needy part of the organism. If the first operation, mastication, be imperfectly done, and the food be swallowed before it is thoroughly ground, an additional duty is imposed upon the stomach, already assigned a sufficiently laborious task.

"To accomplish this will, in some cases, be very difficult. Perhaps it can not be gained at the time the operation for irregularities is being performed. But patience, fellow-practitioner! The employment of wise means, and persistence in their application, will secure the end desired. Nature assists the skillful operator. Let me instance a difficulty. The upper arch is greatly contracted; the molar teeth only meeting their antagonists. The bicuspids, cuspids and incisors all shut inside the lower teeth, none of them touching, none of any use in mastication. What is to be done? Spread the upper arch, of course.

"When this has been done so far as to bring the bicuspids, out to a proper position, it is found that the first bicuspids, for instance, are too short; they will not reach the lower ones. This evil can not be remedied at once. It will not do to seize the tooth and drag it out of its socket far enough to reach its antagonist. But it must come down. How then? Coax it. A ring of rubber left around its neck will produce an irritation sufficient, oftentimes, to accomplish the purpose. But sometimes this will not do. If the mere absence of antagonism will not induce its protrusion, which result often occurs, particularly in adult life; if irritation at the neck is equally unsuccessful, it still can be done by gentle traction.

"Make a plate of rubber or metal, with a reversed gallows under the tooth. To this gallows attach the tooth by an elastic band of slight strength, and the requisite length can soon be gained. This is a delicate operation, and must be carefully performed. No 'heroic' method will do here. Gentle means, often intermitted, again resumed, the effect carefully noted, and a knowledge of what is being done, these will insure the desired result. And even one case of irregularity, successfully brought to a condition which is natural, symmetrical and useful, will amply repay the practitioner for all the study, pains and skill its treatment has cost him."

Sidney Longhurst contributed a paper on *Lateral Abnormalities,* which we find published, page 83, *Transactions of the Odontological Society, Great Britain.*

"A very singular circumstance connected with the upper laterals is the comparative frequency of their absence altogether in some mouths. Doubtless, many practitioners have noticed this omission in two or more mouths of the same family. If we except the wisdom-teeth, I think we may venture the assertion that there is no pair or class the absence of which we have oftener to note; putting, of course, out of consideration those cases where, in childhood, they may have been removed, in error or otherwise, for the purpose of regulation.

"In the union of the permanent teeth, the laterals also will be found to figure conspicuously. Indeed, in almost all the cases sketched by the several dental writers, in the majority, at least, this tooth will be found involved.

"Again, the mould or fashion of these teeth seems to wander more frequently from the normal shape than others. The flattened lower labial surface, so beautifully described in what we are wont to regard as the typical form of lateral, and which, with the non-diastema and short canine, appear to give that expression to the mouth so eminently human, oftentimes, in whole families, seems to degenerate into a small misshapen cone or a mere enameled peg—teeth which, if removed from the mouth, it might well be a subject of conjecture as to what part they had belonged, or whether they had formed any part of the human economy at all!

"Several authors have mentioned cases where three well-developed laterals have been present. I frequently see a gentleman in whose upper jaw there are three, all well-arranged within the arch, and each perfectly formed. These may perhaps be regarded as merely cases of supernumerary teeth, and such undoubtedly they are. But it is to this that I would point: The surplus teeth have been laterals. And, further, that, in three-fourths of the cases of supernumerary teeth I have seen or heard of, I have noticed that the intruder has generally presented itself in this locality, namely, before, between, or behind the centrals and canines. And, lastly, that supernumerary teeth, although occasionally simulating bicuspids and dwarfed molars, yet, as a rule, more closely resemble, in size, position and figure, one of those 'misshapen cones,' or in other words, mal-formed laterals, than any other class of teeth."

Here again we find what careful observations were made and the knowledge our early scientific workers possessed.

DEPARTMENT OF
DENTAL AND ORAL RADIOGRAPHY

JAMES DAVID McCOY, D.D.S., EDITOR
LOS ANGELES, CALIF.

ROENTGENOGRAPHIC STUDY OF INFECTED AREAS ABOUT THE TEETH

BY VIRGIL LOEB, A.B., M.D., D.D.S., ST. LOUIS, MO.
Professor of Oral Surgery, St. Louis University Dental School.

IT has been fully demonstrated that no study of any condition involving the mouth and contained organs is complete without a roentgenographic examination, and further argument to this end is unnecessary. The extent of such an examination, however, depends upon the requirements of the particular case. The purpose of this article is to show, chiefly by the accompanying illustrations, the added information which is always to be obtained when complete sets of roentgenograms are employed in searching for infected areas about the teeth.

Clinical experience has shown us that the general appearance of the tissues about the teeth, together with a consideration of the symptoms enumerated by the patient, often misleads us in determining the particular teeth which are affected. Often we are guided too much by the statements made and fail to find the essential focus because there are no symptoms pointing to it. On this account, it has been my practice for some time, to have roentgenograms of all the teeth made whenever possible. This is important for several reasons. First, definite evidence is provided independent of what the patient may say about his symptoms, by reason of which the physician's or dentist's attention is directed to the pathologic process present. Secondly, we are able to study collectively the normal and pathologic conditions as they exist and in the normal relationship of the teeth.

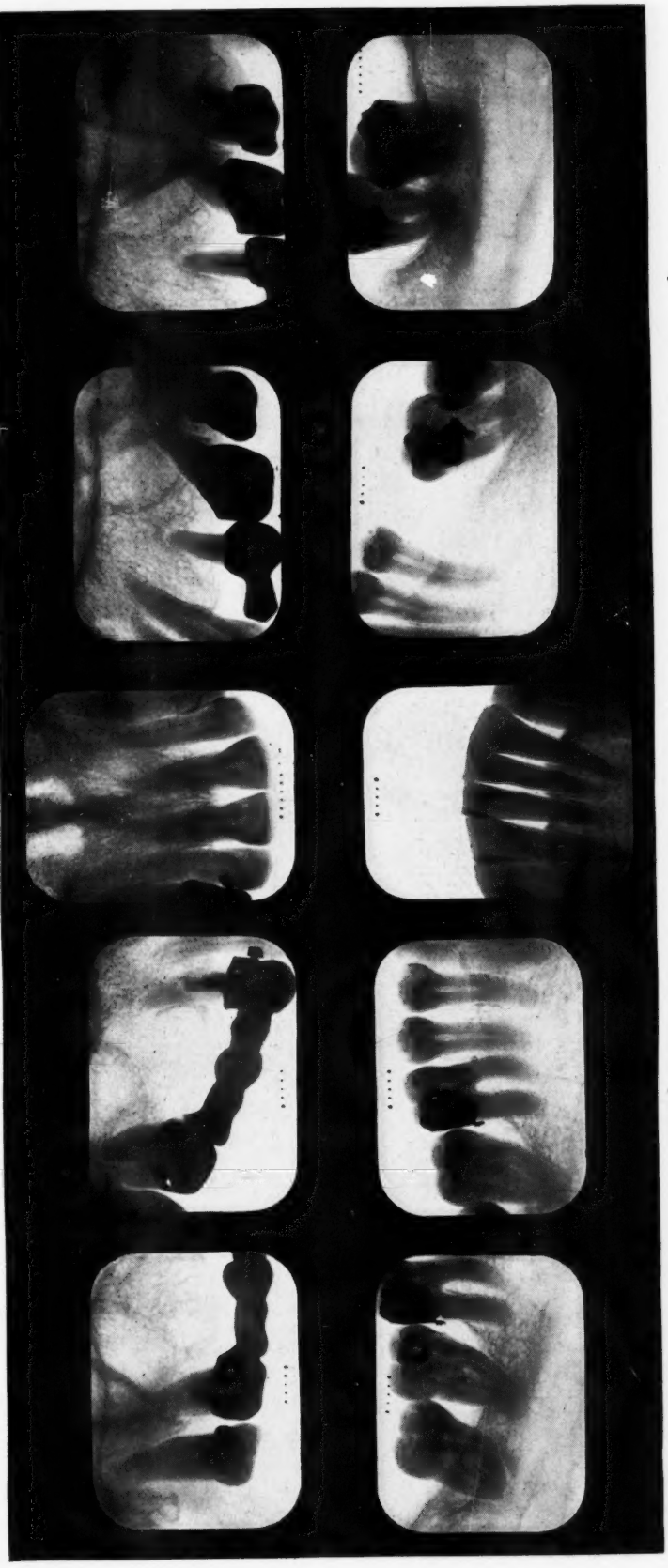
In order to do this in a satisfactory way, it is necessary to arrange and to mount the negatives in some convenient way. This can be done either by mounting the negatives on celluloid sheets, especially made for the purpose, or between two pieces of glass, the pieces being held together by passe partout.

The latter method is to be preferred since it removes any possible chance of injury to the negatives, and it permits a far more convenient filing plan.

The accompanying illustrations show the arrangement of the negatives for study. It is noted that the teeth occupy their normal relation to one another, by reason of which the site of any lesion may be at once identified and fixed. The grouping plan permits the study of the case as a whole so that the operator may determine what teeth to remove and what to retain for artificial work or other purposes.

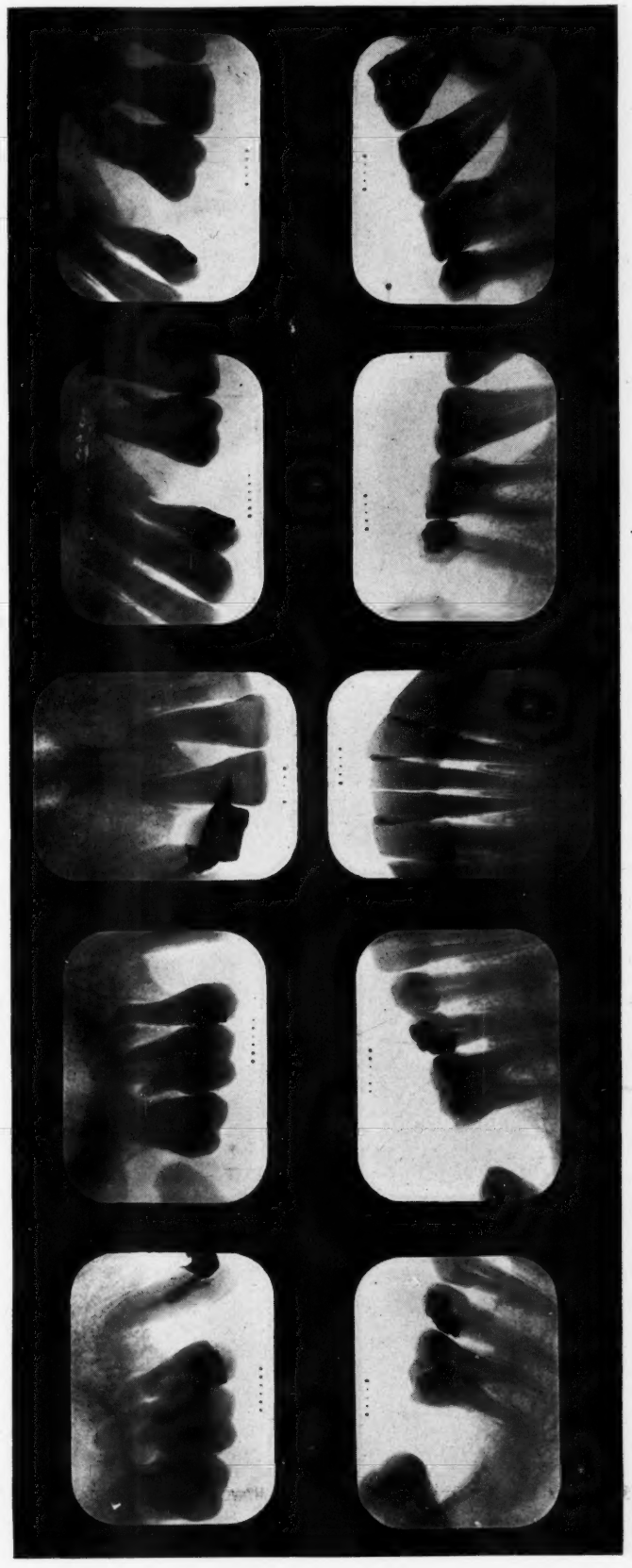
It is not intended to suggest that this method of mounting is new, but to show by the illustrations concrete value of the method.

Case I.—Extensive absorption of alveolus around all teeth with exception of lower right cuspid, bicuspids, and first molar. Lower left lateral incisor is held in position by wire only.

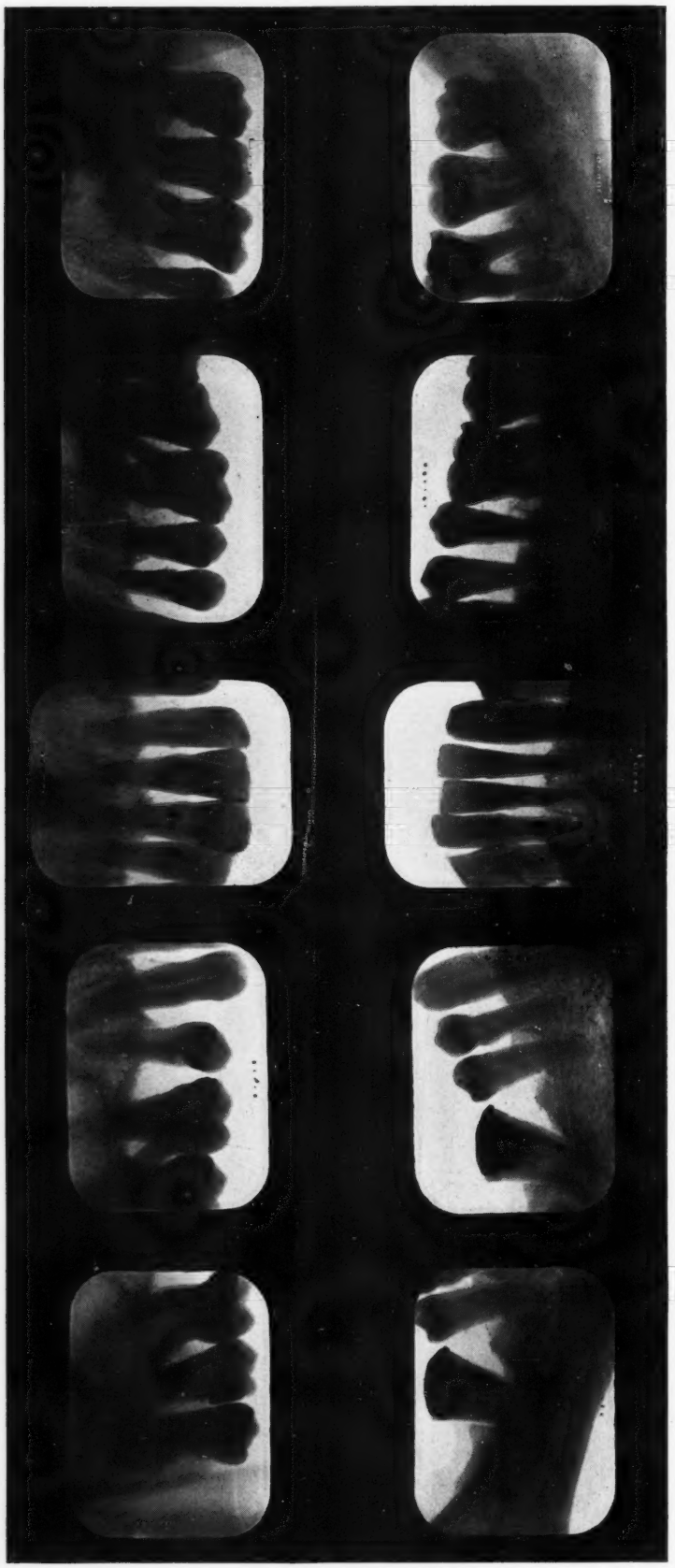


Case II.—Support of all teeth, with exception of upper and lower anterior ones, almost gone, due to absorption.

Case III.—Practically all teeth hopelessly affected due to defected areas at apices of roots and absorption of the process.

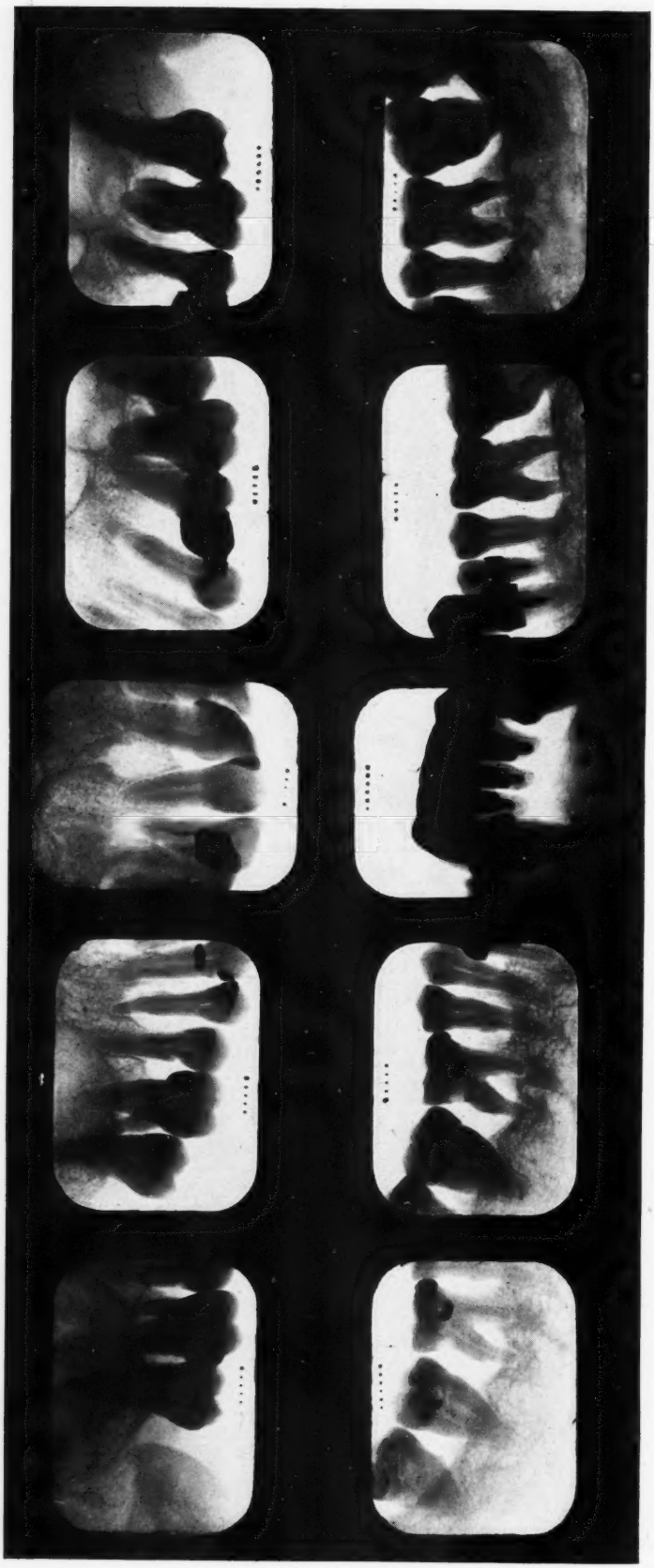


Case IV.—Absorption of alveolus, with complete destruction around lower right second molar and upper right first molar.

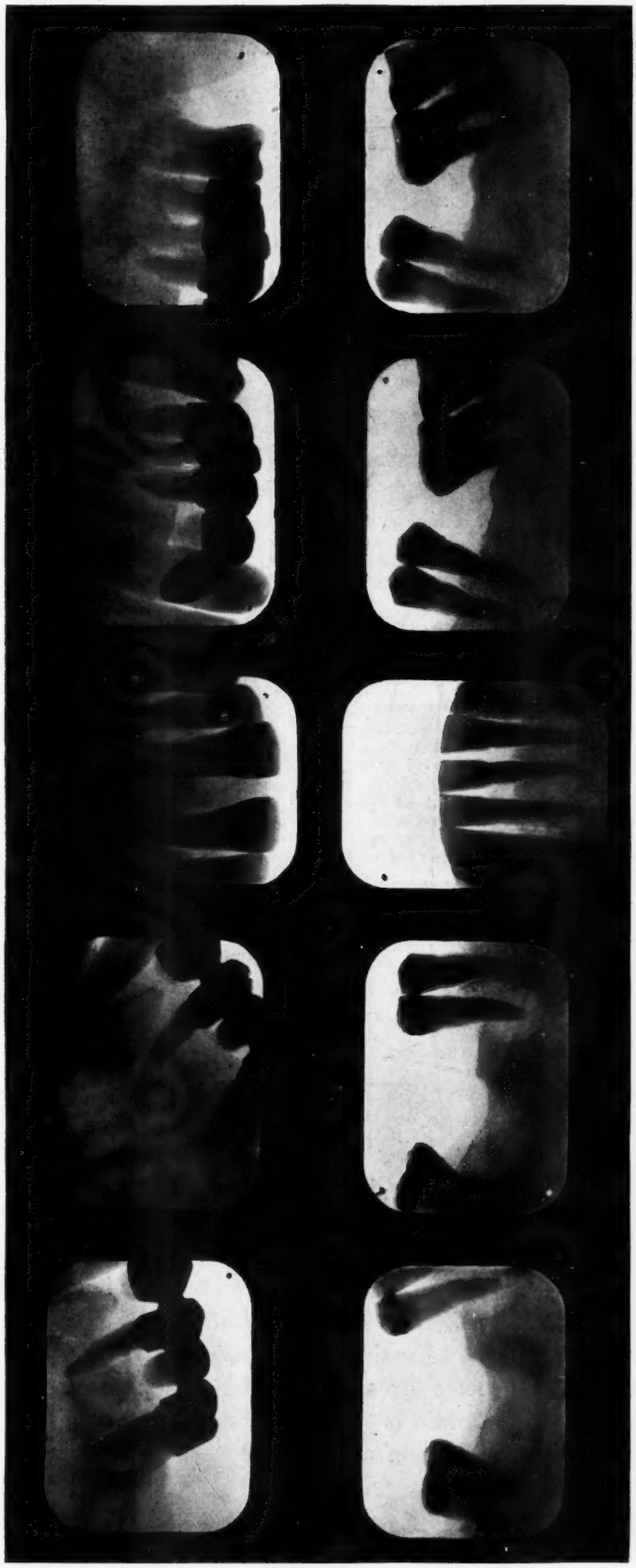


Case V.—General absorption of alveolus. Note symmetry of same.

Case VI.—Absorption of alveolus noted chiefly in upper left molar and lower right molar regions.



Case VII.—Radical absorption of alveolus with definite infected areas at apices of many roots.



Case VIII.—Absorption of process and infected areas at apices of several roots. Hopeless teeth held in position by bridges.

The International Journal of Orthodontia

PUBLISHED THE FIFTEENTH OF EVERY MONTH BY

THE C. V. MOSBY CO., 801-807 Metropolitan Bldg., St. Louis, Mo.

Foreign Depots—*Great Britain*—Henry Kimpton, 263 High Holborn, London, W. C.; *Australasia*—Stirling & Co., 317 Collins Street, Modern Chambers, Melbourne; *India*—"Practical Medicine," Egerton Street, Delhi; *Porto Rico*—Pedro C. Timothee, Rafael Cordero 68, San Juan, P. R.

Subscription Rates—Single Copies, 30 cents. To anywhere in United States, Cuba, Porto Rico, Canal Zone, Mexico, Hawaii and Philippine Islands, $3.00 per year in advance. Under foreign postage, $3.40. English price: 15/ per annum, 1/6 per number. Volume begins with January and ends with December of each year.

Remittances—Remittances for subscriptions should be made by check, draft, postoffice or express money order, or registered letter, payable to the publishers, The C. V. Mosby Company.

Contributions—The editor will be pleased to consider the publication of original communications of merit on orthodontic and allied subjects, which must be contributed solely to this journal.

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Entered at the Post Office at St. Louis, Mo., as Second-Class Matter

EDITORIALS

The Teaching of Orthodontia in Dental Schools

THERE is no subject taught in dental schools about which there are so many different opinions in regard to the proper method of teaching and what should be taught as the science of orthodontics. In times past nearly every dental school taught the subject differently and required a different length of time to be devoted to the subject. It was a common practice with the majority of schools a few years ago, to make orthodontia a part of prosthetic dentistry, and that plan is still followed by some schools at the present time. There is no question but that orthodontia is too large a subject to be given only the small interest it would receive if made a department of prosthetic dentistry or any other phase of dentistry.

In fact, modern orthodontics as we know it today occupies a field which in reality is almost too big to be handled successfully in the dental college

curriculum. However, we are confronted with the fact that orthodontics must be taught, and with the arrangement of a four year course, we are made to realize that orthodontics must be given more of a place than it has had in times past and some standard must be reached for teaching it. In the beginning, we might just as well concede the course must be divided into two parts, that is, a lecture course and a clinical course. You will also be confronted with the proposition that some men believe in giving a very extensive clinical course in orthodontics, while others claim that it should be limited.

We realize the proper procedure lies somewhere between the two extremes. In regard to the lecture course there is not such a difference of opinion as there was in former years. With the progress in orthodontics and the realization that occlusion is the basis of orthodontic study, most lecture courses now begin with the consideration of occlusion of the teeth and a study of the malocclusion as diverging from that point. These lectures on occlusion should include a thorough study of tooth forms with the occlusion of the inclined planes of the teeth. Following that there should be a consideration of the forces of occlusion and the factors establishing normal occlusion and attention must be called to the fact that a perverted force of occlusion will also become a factor in the production of malocclusion. We must make a study of the malocclusion of the teeth and facial deformities based upon the present accepted plan and the student must be familiar with the terminology so he will know what the lecturer is talking about.

The use of the nomenclature adopted at the last meeting of the American Society of Orthodontists will be found to be of great assistance to the men who are teaching orthodontics in dental colleges and they should insist upon the students becoming familiar with it. We believe that no greater step ever was made in the teaching of orthodontics in dental schools than when the American Society of Orthodontists agreed upon a nomenclature which had been worked out by men who had been engaged in teaching orthodontics for a number of years and who, because of their experience, realized that those terms carried a meaning to the students that the terms used in the past did not convey.

It must also be remembered that these courses of lectures to be given to students in orthodontics should be followed by a series of quizzes, or possibly better, the quiz should precede the lecture. When the students are assigned a chapter on a subject in a recognized textbook and allowed to read it, and this is followed by a quiz, we believe the majority of students will obtain a better knowledge if the old lecture system were carefully adhered to and the student expected to gain his knowledge entirely from the lectures. We realize that a great many men can give a lecture which is very instructive and we have also learned from observation that a lecture that is interesting and instructive very often passes over the heads of a majority of the students. By combining the quiz and lesson assigning system with the lecture plan, we believe the student will obtain a greater knowledge of the fundamentals of orthodontics than he will if his entire time be devoted to lectures. A study of the causes of malocclusion must also be considered from every standpoint. Special attention should be paid to those conditions which are produced as a result of mechanical interference with the occlusion of the teeth including conditions produced by

extraction of the deciduous teeth and other dental operations, but we must also remember that a certain number of malocclusions have their beginning in constitutional conditions which must be emphasized. While a number of malocclusions are influenced by the mechanics of the teeth or by the forces of occlusion, there is also a large percentage of malocclusions produced by faulty cell metabolism having its origin in constitutional conditions which have not been recognized as they should have been in times past.

When we come to the consideration of regulating appliances as they should be taught in dental schools, we realize we are reaching a subject about which there is going to be much discussion. Men who have a particular style of regulating appliance believe that appliance is the only one that should be taught to students. If orthodontics is a science the question of regulating appliances should be taught in a purely scientific manner, based upon recognized physical and mechanical rules. Therefore, the study of regulating appliances should begin with a study of the physics of appliances and every appliance considered should be considered from the standpoint of efficiency based upon recognized mechanical laws. If this plan is followed, the student will be able to consider regulating appliances upon their merit and not because the appliance is advocated by a particular individual or pushed by a particular commercial concern.

Retaining appliances should be considered in the same way and special attention both in regard to the regulating appliances and retaining appliances should be paid to the histology and the physiology of tooth movement. We realize that a regulating appliance is simply a means of exerting force upon a malposed tooth for the purpose of creating cell activity, as cell activity is a necessary adjunct in the proper treatment of the malocclusion. It, therefore, follows that a proper course in orthodontics will be one that will include a study of the tissues surrounding the teeth, and if this course is given under the chair of histology in colleges it will relieve the man, who is teaching orthodontics, of considerable work.

One great trouble in times past has been that dental anatomy has not been properly taught from the standpoint of occlusion, and consequently the man who taught orthodontics was also compelled to teach more or less dental anatomy. Likewise, in histology no attention was paid to the tissues surrounding the tooth from the standpoint of orthodontic treatment and consequently the man who taught orthodontics was compelled to devote more or less time to histology. If the courses in dental anatomy, histology, and orthodontics can be worked together, each man teaching the subjects so as not to overlap one another and still laying the proper importance upon each phase that is required from an orthodontic standpoint, it will relieve much of the difficulty encountered in times past in teaching dental students.

When we come to the consideration of the treatment of cases there is no question but that an outline of the different principal types of cases should be given in a lecture course. The student should be assigned from a text the treatment of the different types outlined in textbooks and the lecturer supplement such study with certain cases from his own practice. When we come to the treatment, we are confronted with the question as to what should be done in the way of clinical orthodontia.

In times past the orthodontic clinic in dental schools has been very much abused and very poorly and unsatisfactorily conducted. In some schools the orthodontic clinic has been under the supervision of some man engaged in other work and the students have been assigned a certain number of malocclusions which they were to treat. In some schools the students treated one or two cases during their senior year and in the majority of instances with very unsatisfactory results. The reason for this has been that the student, as a rule, has had very little interest in the subject and the lecture course has probably been incomplete and insufficient and he has not had a demonstrator in charge of the case who was particularly interested in the outcome of the treatment. Because of this the appliances have been poorly constructed and poorly made, and the result from the standpoint of treatment unsatisfactory. Very few students are able to finish a case during their college year, and the case passes from one class to another with more or less unsatisfactory results. We realize occasionally that a student will get a satisfactory result in the treatment of his case and in some instances much good will be accomplished. In some instances we have seen results which are very unsatisfactory and the patient would have been much better if nothing had been done. However, this by no means solves the situation and we realize that something must be done in regard to the standardization of orthodontic clinics in dental schools.

The best way to accomplish this standardization is for the dental schools to realize that the orthodontic clinic must have demonstrators in charge who are interested only in that line of work. There must also be a sufficient number of demonstrators to carefully supervise the construction of all appliances and see that they are properly applied, and that the student does not neglect the work. In addition to that we believe the demonstrator should carry a certain number of cases through under his own personal supervision, doing all the work upon those cases and having the student observe the proper treatment of those cases under his care. By this plan we really believe that much good can be accomplished and probably more real instruction given to students than can be obtained in any other way. However, we realize that the number of cases the demonstrator could take care of himself would be limited and there is left a large number of cases of malocclusion which could not receive treatment because of financial conditions unless they can receive the same in a dental college clinic. We realize that when we advocate that the dental student should treat malocclusions in dental college clinics, a large number of practicing orthodontists are going to be opposed to that plan and they are opposed to it more or less justly. Their opposition is based on the unsatisfactory results they have seen in times past and there will continue to be unsatisfactory results even under the most favorable conditions. However, conditions can be improved by having a competent number of demonstrators as we have suggested in other parts of this editorial. Dental students perform operations upon patients in other lines of dentistry, they fill root canals, they make bridges, they construct plates, and in a great many instances render the patient a service, and in many more instances the work is not up to standard. However, people who attend dental college clinics realize the work is being done by students

and they can hardly expect the same results they would expect from one with years of practice or who was especially skilled in that particular line of work.

The same is true in the correction of malocclusion. There are a large number of malocclusions which students could improve and benefit even though the results were not so ideal as would be obtained by a practitioner of orthodontia in private practice. We also realize that in each dental class there are a number of students who are interested in orthodontics and would probably be glad to take up the practice of orthodontics in later years. We also realize that there are a number who have no interest in orthodontics and do not care for the work, and as a result of that, experience in an orthodontic clinic to a certain extent separates the desirables from the undesirables. To those who have not the painstaking care necessary for the practice of orthodontics, nothing will so forcibly impress it upon them as to attempt to treat a case in a college clinic. By treating a case or two in a college clinic, a great many men will not attempt any more cases after they go into general practice and as a result of that the public will be relieved of a large number of failures and unsatisfactory conditions which we have seen in private practice from men who, because of inexperience in a college clinic, concluded that the treatment of malocclusions was very easy.

We realize the fact that it is almost impossible to get a group of orthodontists to agree upon the proper plan of teaching the science in dental colleges; nevertheless, the subject must be taught, and is being taught; and the sooner orthodontists realize that they can advance orthodontics by reaching some concerted basis for the teaching of the same in dental colleges, the better it will be for the science.

Report of the Committee on Nomenclature

AT the meeting of the American Society of Orthodontists, held at Excelsior Springs, Missouri, the Committee on Nomenclature recommended the use of the following terms which were adopted by the Society:

Neutroclusion to designate such malocclusions as are characterized by normal mesio-distal or normal antero-posterior relation of the lower dental arch to the upper dental arch.

Distoclusion designates such malocclusions as are characterized by a distal or posterior relation of the lower dental arch to the upper dental arch.

Mesioclusion to designate such malocclusions as are characterized by a mesial anterior relation or of the lower dental arch to the upper dental arch.

Malpositions of the teeth to be defined as the relation which the individual teeth bear to the normal line of occlusion, the median line of the face and the individual denture.

Mandibular teeth to be used in preference to lower or inferior teeth.

Maxillary teeth to be used in preference to upper or superior teeth.

Mesioversion—a tooth which occupies a position too near the median line of the face.

Distoversion—a tooth too far from the median line of the face.

Buccoversion—a tooth which occupies a position buccally to the line of occlusion.

Linguoversion—a tooth which occupies a position lingually to the line of occlusion.

Supraversion—a tooth which is too long as related to the plane of occlusion.

Infraversion—a tooth which is too short as related to the plane of occlusion.

Torsiversion—a tooth which is rotated on a perpendicular axis.

Transversion—a tooth which is in the proper vertical plane, but is in incorrect numerical order.

Perversion—an impacted tooth lying in an abnormal plane.

Deformity of the jaws to be used in reference to extreme malformations and maldevelopments.

Macromandibular Deformity—a mandible which is too long.

Macromaxillary Deformity—a maxillary which is too large.

Micromandibular Deformity—a mandible which is too small.

Micromaxillary Deformity—a maxillary which is too small.

Orthodontia to be used for the practice.

Orthodontics to be used for the science.

Orthodontic to be used for the adjective.

Orthodontist, one who practices orthodontia.

In studying the list of terms as presented by the Committee on Nomenclature it will be observed that the words ending in *clusion* are used in description of the relation of one arch to the other. In speaking of the position of single teeth they are spoken of as malpositions in order to avoid confusion of the position of individual teeth with arch relation.

The ending *version* is used to designate the position of an individual tooth because it has been found less confusing with students to explain different positions of malocclusion and arch relations if terms are used having different endings.

It will also be observed that the committee has recommended the use of *mandibular* and *maxillary* in preference to the words *inferior* and *superior.* It is hoped the dental profession will use those terms as they are more scientific in describing teeth than the words *upper* and *lower* or *superior* and *inferior.* It will also be noted that the term *torsiversion* has been adopted to describe a rotated tooth in preference to the term formerly applied *torsoversion* or *torsoclusion.* The ending *i* in preference to *o* was adopted because it is more descriptive and more correct. The terms used to describe deformities of the jaws we believe are self-explanatory. The committee was also wise in suggesting the use of *orthodontia, orthodontics,* and *orthodontic,* for we are now enabled to have a terminology which describes the practice and appliances used more accurately than terms formerly employed. While the work of the committee is by no means complete, we believe that the science will be advanced by using a more definite terminology than was formerly employed.

Oral Abscesses*

WITH the development of dentistry as a science and greater attention being paid to bacteriology and pathology of the teeth and the surrounding structures, it is only right and proper that a book should appear devoted to the subject of oral abscesses. The book as written by Dr. Thoma includes the study of phenomena of infection, the various principles involved in the process of infection, local, general, and secondary. The classification of abscesses is considered, as well as the pathologic development and diagnosis of alveolar abscesses caused by diseases of the dental pulp. A very complete classification of the varieties of peridontitis is taken up along with the etiology of the disease, complications, and termination.

The histopathology is also considered along with secondary complications following the treatment of oral abscesses. We may not exactly agree with everything the author says in regard to classifications of causes and conditions; we may not agree with the treatment he advocates in all instances; however, the book is a valuable addition to any library. Its illustrations can not be surpassed and it fills a long felt want, owing to the fact that it is a book devoted to one particular phase of dentistry and the author has confined himself to his subject. The book should be in the hands of every dental practitioner, for by careful study of its pages he will have a much greater respect for conditions associated with, and known as, oral abscesses than he has had in times past. Many radiographs are shown, as well as a number of colored illustrations. The book as a whole is a credit to the author and its publishers and a valuable adjunct to dental literature.

*Oral Abscesses. By Kurt H. Thoma, D.M.D., Lecturer on Oral Histology and Pathology and Member of the Research Department of Harvard University Dental School, etc. 213 pages, 293 illustrations. Published by Ritter & Company, Boston, 1916.